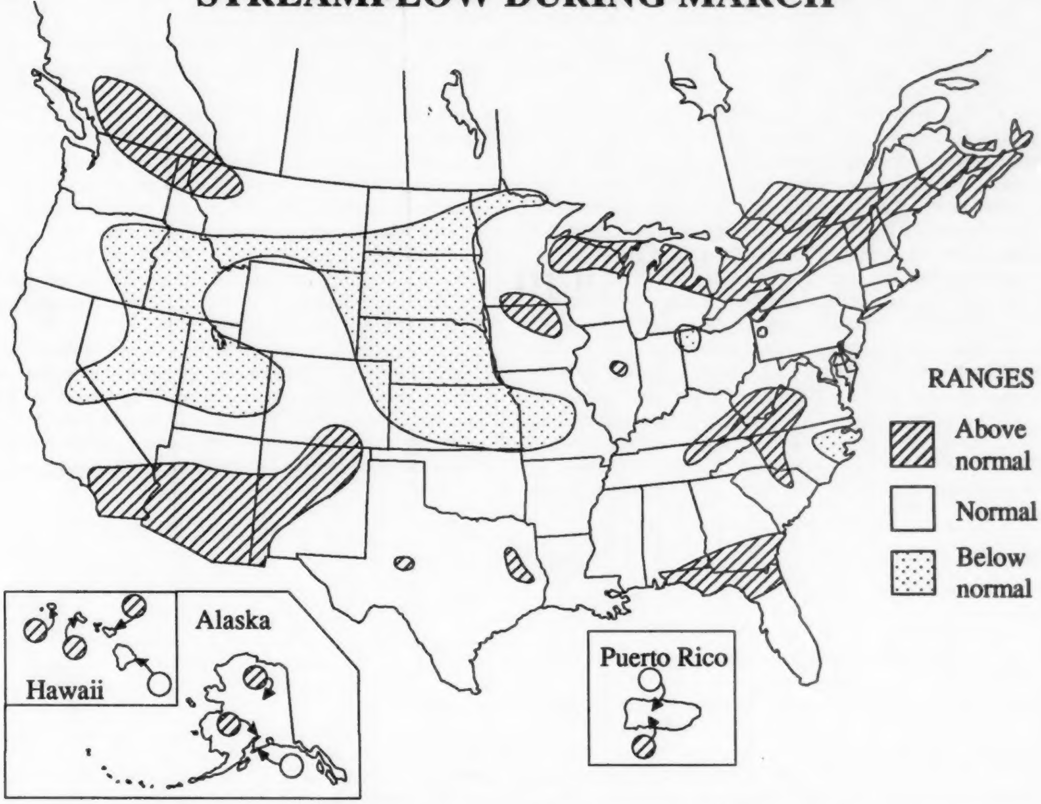
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

MARCH 1991

STREAMFLOW DURING MARCH



Heavy rains in Hawaii March 19-23 caused severe floods, mudslides, a power outage which lasted for several hours on the island of Oahu, and damages which were probably in the millions of dollars. Peak discharges exceeded those of record at two gaging stations on Oahu. According to the National Weather Service, precipitation amounts for the storm series varied from about 9 inches along the Waianae Leeward Coast and normally dry side of the island to about 34 inches at Waiahole close to the mountains near the north end of Kaneohe Bay.

Streamflow was in the normal to above-normal range at 85 percent of the index stations in the United States, southern Canada, and Puerto Rico during March and below-normal range streamflow occurred in 16 percent of the area of the conterminous United States and southern Canada. Total flow for the 174 index stations in the conterminous United States and southern Canada was 13 percent above median.

The combined flow of the 3 largest rivers in the lower 48 States--Mississippi, St. Lawrence, and Columbia--averaged 23 percent above median and in the above-normal range. Flow of the St. Lawrence River was a record high for March. Flow of the Mississippi and Columbia Rivers was in the normal range.

Month-end index reservoir contents were in the below-average range at 36 of 100 reporting sites, and in the above-average range at 42 reservoirs. Only two reservoirs had less than 10 percent of normal maximum contents: Lake Tahoe, California-Nevada; and Rye Patch, Nevada.

Mean March elevations at four master gages on the Great Lakes (provisional National Ocean Service data) were in the normal range on both Lake Superior and Lake Huron, and in the above-normal range on both Lake Erie and Lake Ontario.

Utah's Great Salt Lake was at 4,202.70 feet above National Geodetic Vertical Datum of 1929 at the end of March, 9.15 feet lower than the maximum of record.

SURFACE-WATER CONDITIONS DURING MARCH 1991

Heavy rains in Hawaii March 19-23 caused severe floods, mudslides, a power outage which lasted for several hours on the island of Oahu, and damages which were probably in the millions of dollars. Peak discharges exceeded those of record at two gaging stations on Oahu. Peak discharge of Kipapa stream near Wahiawa (35 years of record) on March 20 was 6,400 cubic feet per second (cfs) at a stage of 12.67 feet, with a recurrence interval of about 75 years. The March 20, 1991, peak was 720 cfs and 0.38 foot higher than the previous high in 1963. Peak discharge of Punaluu stream near Punaluu (39 years of record) on March 21 was 7,180 cfs at a stage of 8.34 feet, with the peak discharge about 1.29 times that of the 100-year flood. The March 21, 1991, peak was 1,480 cfs and 0.74 foot higher than the previous peak of record in 1974. The following description of the storms was excerpted from a special weather statement by the Honolulu Office of the National Weather Service.

"Heavy flooding occurred over some portions of the island of Oahu. Precipitation amounts varied from about 9 inches along the Waianae Leeward Coast and normally dry side of the island to about 34 inches at Waiahole close to the mountains near the north end of Kaneohe Bay.

"The heavy precipitation that fell over Oahu came in essentially three different periods. The first and heaviest episode of rainfall started during the afternoon and evening hours of Tuesday, March 19 extending into the early morning hours of Wednesday, March 20. Satellite photos indicate heavy moist clouds were being brought northeastward from deep in the tropics, 1000 miles to the southwest of Oahu. Near the surface, southeasterly winds prevailed and moisture plumes extended from one island to the next with the "Molokai Plume" moving up along the Koolaus much of the time. The heavy rains affected mainly the windward side. The Ahuimanu Loop rain gage near Kahaluu on Central Kaneohe Bay, recorded 14.27 inches in 13 hours between noon Tuesday and 1 a.m. Hawaii Standard Time (HST) Wednesday. Some very intense rainfalls also occurred near Kahuku around 3 a.m. HST Wednesday morning.

"The second period of heavy rain occurred during the predawn hours of Thursday, March 21. A stationary cell developed which sat for several hours on the lee slopes of the Koolaus dropping copious amounts of rainfall above Pacific Palisades, Mililani and Waipio. No rain gage was in the area of most intense rainfall where probably about 10 inches fell in 3 hours between midnight and 3 a.m. HST Wednesday March 21.

The third episode of heavy rains occurred on Saturday, March 23. It started about 12 noon HST as a band of heavy showers moved in from the south. This cloud and shower band was an old plume cloud shed by the Big Island. This band eventually merged with another cloud band coming in from the Kauai Channel. These rains affected all areas of Oahu including the Hawaii Kai area with intense downpours."

Streamflow was in the normal to above-normal range at 85 percent of the index stations in the United States, southern Canada, and Puerto Rico during March, compared with 79 percent during February, and 70 percent of stations in those ranges during March 1990. Below-normal range streamflow occurred in 16 percent of the area of the conterminous United States and southern Canada during March 1991, compared with 20 percent during both February 1991 and March 1990. Total March 1991 flow of 1,041,000 cfs for the 174 index stations in the conterminous United States and southern Canada was 13 percent above median, 20 percent more than last month, and 17 percent more than flow during March 1990.

Eight new extremes (table on page 4), three lows and five highs, occurred at streamflow index stations, compared with five lows and two highs during February. The lows occurred at stations in Nebraska, Kansas, and Idaho, while the highs occurred at stations in Georgia, Florida, and Alaska, and also on the St. Lawrence River. Hydrographs for those stations where new extremes occurred are on page 5, except

(Continued on page 4)

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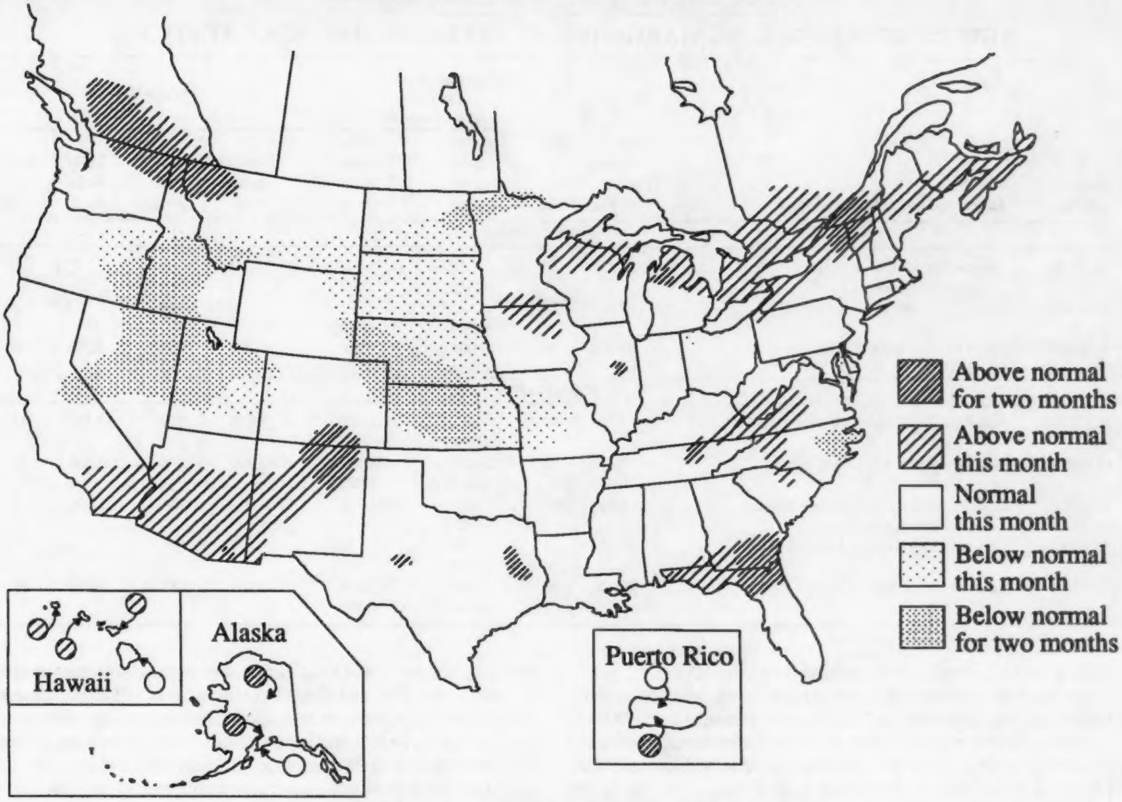
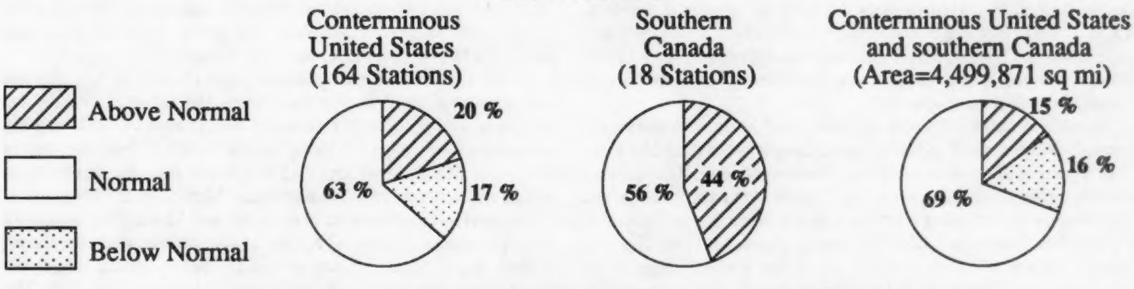
MARCH 1991 STREAMFLOW RANGES

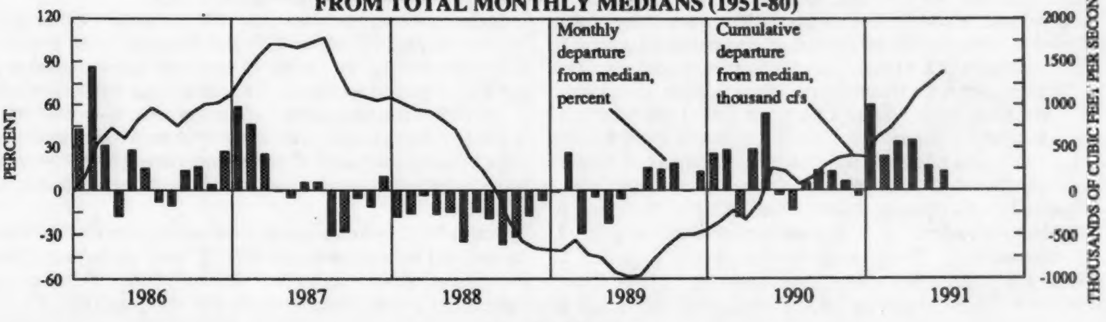


SUMMARY OF MARCH 1991 STREAMFLOW

FLOW RANGES



MONTHLY AND CUMULATIVE DEPARTURE OF TOTAL MONTHLY MEANS FROM TOTAL MONTHLY MEDIANS (1951-80)



NEW EXTREMES DURING MARCH 1991 AT STREAMFLOW INDEX STATIONS

				Previous March extremes (period of record)		March 1991			
Station number	Stream and place of determination	Drainage area (square miles)	Years of record	Monthly mean in cfs (year)	Daily mean in cfs (year)	Monthly mean in cfs	Percent of median	Daily mean in cfs	Day
	LOW FLOWS								
06454500	Niobrara River above Box Butte Reservoir, Nebraska	1,400	44	36.3 (1981)	20.0 (1967)	31.6	60	27.0	17
06867000	Saline River near Russell, Kansas	1,502	39	11.0 (1989)	5.00 (1984)	9.25	20	4.08	1
13269000	Snake River at Weiser, Idaho	69,200	80	11,000 (1935)	9,320 (1977)	10,100	50	8,520	19
	HIGH FLOWS								
02317500	Alapaha River at Statenville, Georgia	1,400	59	7,045 (1984)	12,600 (1984)	7,776	379	17,100	10
02320500	Suwannee River at Branford, Florida	7,880	59	26,920 (1948)	38,500 (1948)	30,900	274	37,600	18
04264331	St. Lawrence River at Cornwall, Ontario, near Massena, New York	298,800	130	314,400 (1987)	338,000 (1987)	316,000	126	325,000	*
15290000	Little Susitna River near Palmer, Alaska	61	42	27.7 (1968)	35.0 (1982)	30.5	154	33.0	1
15515500	Tanana River at Nenana, Alaska	25,600	28	7,497 (1986)	7,800 (1970)	7,548	122	7,600	17

*Occurred more than once.

that for the St. Lawrence River, which is on page 10.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged 1,457,000 cfs; 23 percent above median and in the above-normal range, after a 9 percent increase in flow from February to March. Flow of the St. Lawrence River was in the above-normal range for the second consecutive month and a record high for March. Flow of the Mississippi River was in the normal range for the second consecutive month. Flow of the Columbia River was in the normal range for the third consecutive month. Hydrographs for both the combined and individual flows of the "Big 3" are on page 10. Dissolved solids and water temperatures at five large river stations are also given on page 10. Flow data for the "Big 3" and 42 other large rivers are given in the Flow of Large Rivers table on page 11.

Month-end index reservoir contents were in the below-average range (below the month-end average for the period of record by more than 5 percent of normal maximum contents) at 36 of 100 reporting sites, compared with 35 at the end of February (and also 35 at the end of March 1990), including most reservoirs in Nova Scotia, Nebraska, the Dakotas, Montana, Idaho, Wyoming, Colorado, Utah, Nevada, and California. Contents were in the above-average range at 42 reservoirs (compared with 48 last month), including most reservoirs in Maine, New Hampshire, Vermont, Massachusetts, New York, New Jersey, Maryland, the Carolinas, Georgia, the Tennessee Valley, Texas, Arizona, Wisconsin, and Minnesota. Reservoirs with contents in the below-average range and significantly lower than last year (with normal maximum contents of at least 1,000,000 acre-feet) are: Lake McConaughy, Nebraska; Hungry Horse, Montana; Boise River, Idaho; Bear Lake, Idaho-Utah; Folsom, Clair Engle Lake, Lake Berryessa, and Shasta Lake, California; and also the Colorado River Storage Project. Only two reservoirs had less than 10 percent of normal maximum contents (March average in parentheses): Lake Tahoe, California-Nevada, 0 percent (54); and Rye Patch, Nevada, 6 percent (64). Graphs of contents for seven reservoirs are shown on page 12 with contents for the 100 reporting reservoirs given on page 13.

Mean March elevations at four master gages on the Great Lakes (provisional National Ocean Service data) were in the normal range on both Lake Superior and Lake Huron, and in the above-normal range on both Lake Erie and Lake Ontario. Levels fell from those for February on Lake Superior, remained unchanged on Lake Huron, and rose on both Lake Erie and Lake Ontario. March levels ranged from 0.10 foot lower (Lake Superior) to 0.24 foot higher (Lake Erie) than those for February. Monthly means have now been in the normal range for 2 months on Lake Superior and 10 months on Lake Huron. Means on both Lake Erie and Lake Ontario were in the above-normal range for the third consecutive month. March 1991 levels ranged from 0.19 foot (Lake Superior) to 0.96 foot higher (Lake Ontario) than those for March 1990. Stage hydrographs for the master gages on Lake Superior, Lake Huron, Lake Erie, and Lake Ontario are on page 14.

Utah's Great Salt Lake (graph on page 14) was at 4,202.70 feet above National Geodetic Vertical Datum (NGVD) of 1929 at the end of March. The seasonal low of 4,202.20 feet above NGVD of 1929 occurred on November 22, 1990. Lake level is 2.00 feet lower than at the end of March 1990, and 9.15 feet lower than the maximum of record which occurred in June 1986 and March-April 1987.

Streamflow conditions for March 1991 and March 1990 are shown by maps on page 15. March 1991 has 29 percent less area in the above-normal range, 20 percent less area in the below-normal range, and about 17 percent more area in the normal range than March 1990. The locations of reservoirs with below-average contents at the end of both months are also shown on the respective maps.

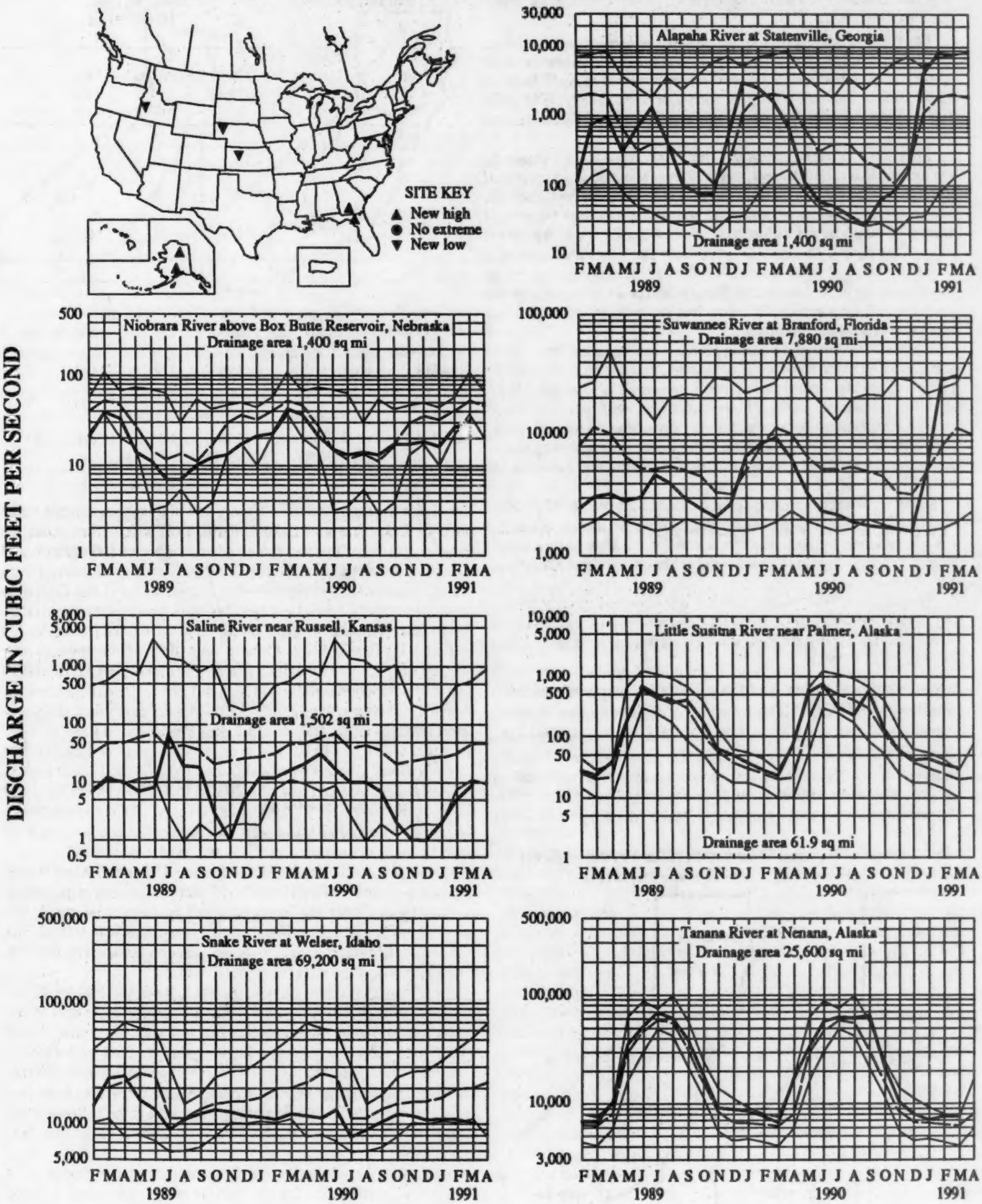
Streamflow conditions for winter 1991 and winter 1990 are shown by maps on page 16. Winter 1991 has 15 percent more area in the above-normal range, the same total area in the below-normal range, and about 5 percent less area in the normal range than winter 1990.

Streamflow conditions for fall-winter 1991 and fall-winter 1990 are shown by maps on page 17. Fall-winter 1991 has 69 percent more area in the above-normal range, 35 percent more area in the below-normal range, and about 21 percent less area in the normal range than fall-winter 1990.

Graphs for 12 hydrologic areas show monthly percent departure of streamflow from median for the 1986-91 water years (page 18) and also compare monthly streamflow for the 1990 and 1991 water years with median monthly streamflow for 1951-80 (page 19).

MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



HYDROLOGIC CONDITIONS AND WATER-SUPPLY OUTLOOK IN CALIFORNIA

From *California Water Supply Outlook* (Department of Water Resources, Division of Flood Mangement, Flood operations and Hydrology Branches)

On the average, April 1 is the peak of snowpack accumulation. Normally, about 83 percent of the water year precipitation has occurred; about half the remainder (9 percent) can be expected in April. Because most of the rain and snow are past, and the season of heavy water usage is beginning, the April 1st water supply conditions and forecast are most important.

March precipitation, statewide, was nearly three times average for the month. This raised the seasonal total from about 35 to 75 percent of average. The percentages were highest in the southern half of California, above normal at some stations, and somewhat less than the overall average in the northern California mountain watersheds which generate most of the runoff. As a result, forecasted water year runoff overall is about half average. With normal future weather, expected water year runoff amounts in the Sacramento Basin would be about the same as last year, but will be significantly more than last year in the central and southern portions of California.

The snow accumulation during March was something for all to be thankful about as the snow water content increased from about 15 to 75 percent of average. April through July snowmelt is forecasted to be about 65 percent of average. Snowmelt runoff will be less than the snowpack percentage because of the very dry winter antecedent conditions and, to some extent, because water losses (primarily vegetation use) are relatively fixed, leaving a smaller fraction of the snowpack for surface runoff compared to a normal pack.

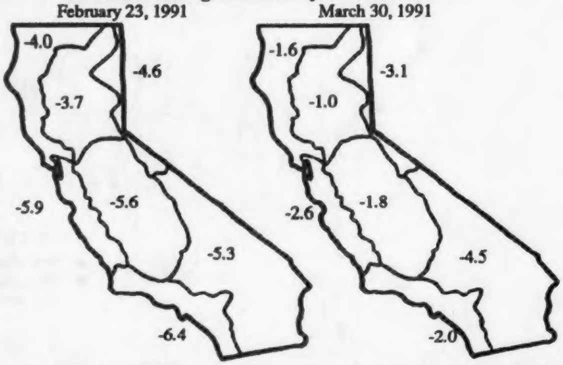
Reservoir storage increased about 4 million acre-feet (MAF) during March or from 48 to 60 percent of average. However, it is still about 31/2 MAF less than last year and the lowest for this date of the current drought years. Storage in 1977 at the end of March was about 3 MAF less than this year.

So, while the water supply outlook has improved greatly from a month ago, especially in California's Central Coast, storage and forecasted runoff generally are well below levels needed to furnish normal water supplies in 1991.

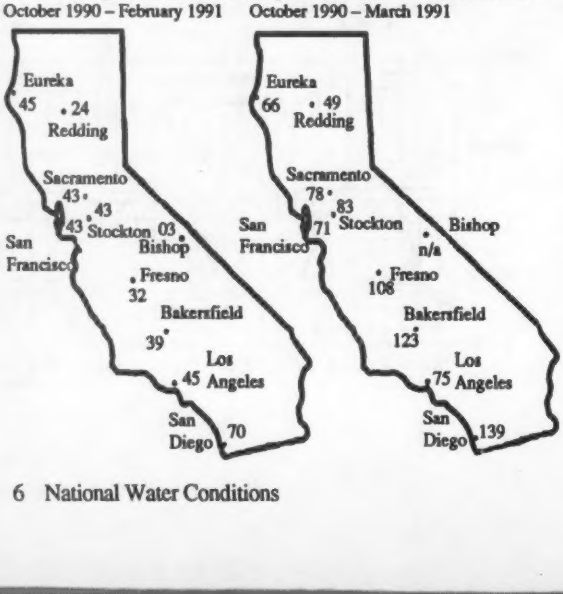
(From *Weekly Weather and Crop Bulletin*, prepared and published by the NOAA/USDA Joint Agricultural Weather Facility)

Four substantial rounds of precipitation in March provided a dramatic easing of California's 5-year drought. The graphs below show the impact of the storms on water year percentage of normal precipitation and Palmer drought indices. Monthly precipitation ranged from 150 to 550 percent of normal statewide, including a record-setting 12.33 inches in Santa Barbara (507 percent of normal) and 9.41 inches in Santa Maria (503 percent of normal). Alpine Meadows, CA, received more than 180 inches of snow for the month. The Sierra Nevada water equivalent precipitation was impressive: 8 to 28 inches. The significant periods of rain and snow have been likened to the storminess of the "miracle March" of 1978, when the State's last serious drought was vanquished.

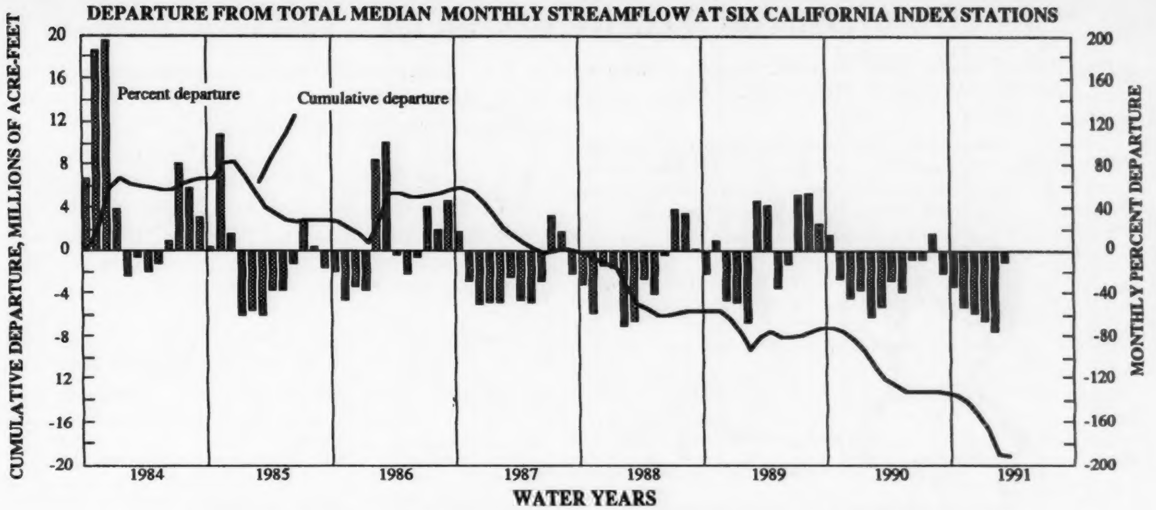
Palmer Drought Indices by Climatic Division



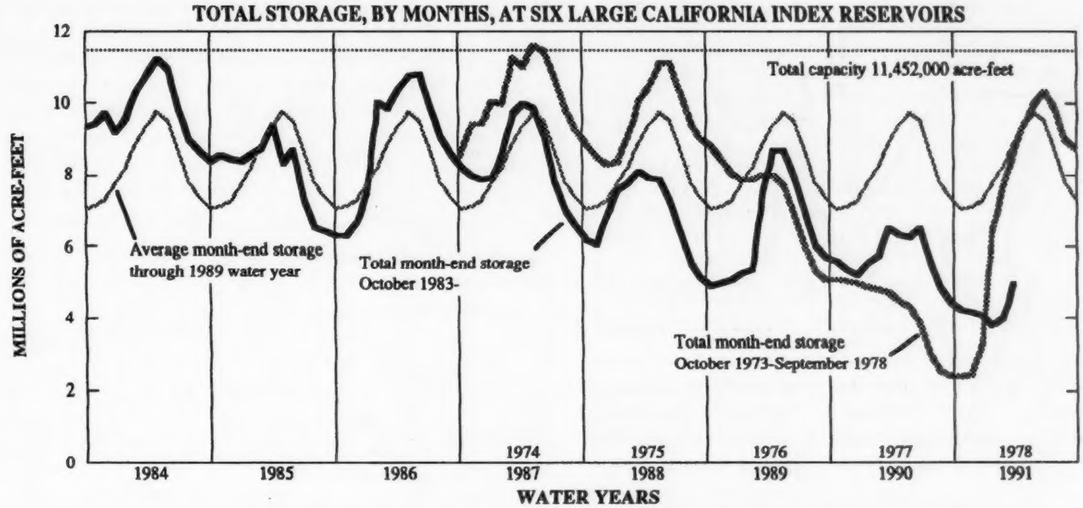
Percentage of Normal Precipitation for Period Indicated



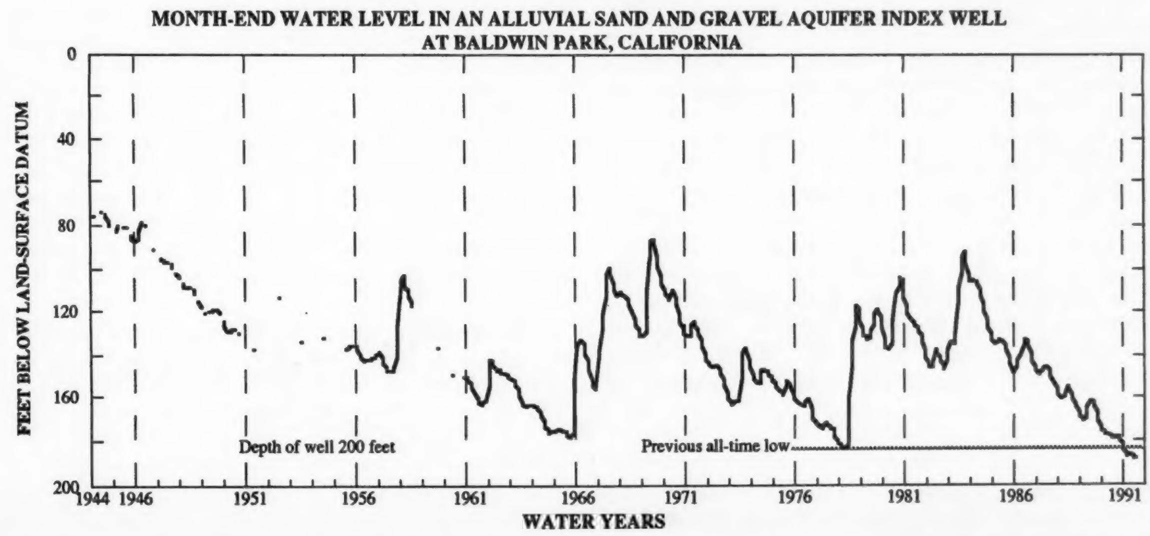
LOCATION OF SELECTED U.S. GEOLOGICAL SURVEY INDEX STATIONS IN CALIFORNIA



DEPARTURE FROM TOTAL MEDIAN MONTHLY STREAMFLOW AT SIX CALIFORNIA INDEX STATIONS
CUMULATIVE DEPARTURE, MILLIONS OF ACRE-FEET
MONTHLY PERCENT DEPARTURE
Percent departure
Cumulative departure
20
16
12
8
4
0
-4
-8
12
-16
-20
200
160
120
80
40
0
-40
-80
-120
-160
-200
1984
1985
1986
1987
1988
1989
1990
1991
WATER YEARS



TOTAL STORAGE, BY MONTHS, AT SIX LARGE CALIFORNIA INDEX RESERVOIRS
MILLIONS OF ACRE-FEET
Total capacity 11,452,000 acre-feet
Average month-end storage through 1989 water year
Total month-end storage October 1983-
Total month-end storage October 1973-September 1978
12
10
8
6
4
2
0
1974
1975
1976
1977
1978
1984
1985
1986
1987
1988
1989
1990
1991
WATER YEARS



MONTH-END WATER LEVEL IN AN ALLUVIAL SAND AND GRAVEL AQUIFER INDEX WELL
AT BALDWIN PARK, CALIFORNIA
FEET BELOW LAND-SURFACE DATUM
Depth of well 200 feet
Previous all-time low
0
40
80
120
160
200
1944
1946
1951
1956
1961
1966
1971
1976
1981
1986
1991
WATER YEARS

HYDROLOGIC CONDITIONS IN THE GREAT BASIN

LOCATION OF SELECTED U.S. GEOLOGICAL SURVEY INDEX STATIONS IN THE GREAT BASIN

Streamflow conditions at four index stations in the Great Basin since October 1985 show the monthly progression from a time of above-average precipitation and streamflow during the 1986 water year through the latest period of drought. The cumulative departure line is steepest when large monthly departures occur. The two best examples of this are February-April 1986—very wet months (a time during which severe floods occurred in California), with each month having more than twice the average streamflow—and May-June 1987—very dry months, with a combined flow of only 46 percent of the average streamflow for those months. Similarly dry conditions occurred in April-June 1988 and 1989, with only a relatively wet March-April 1989 interrupting the progressive downward trend.

Most of the precipitation which produces runoff and ground-water recharge in the Great Basin occurs from December through May, the bulk of it from March through May. Two-thirds of the combined runoff for an average year at: **Weber River near Oakley, Utah; Beaver River near Beaver, Utah; Humboldt River at Palisade, Nevada; and West Walker River below Little Walker River, near Coleville, California;** occurs from April through June, the bulk of it during June. Snow at higher elevations, usually beginning to melt in March, occasional rainfall, and ground-water discharge sustain streamflow during the year. Streamflow usually reaches seasonal lows during August-October in the Great Basin. Each month of the 1991 water year has been drier than the corresponding month of the 1990 water year, with even a 70 percent increase in flow from January to February leaving February streamflow at only 55 percent of average.

Weber River near Oakley, Utah—In the northeastern part of the Great Basin, about 30 miles east of Salt Lake City, draining to the west from the Uinta Mountains and directly to the Great Salt Lake, with a drainage area of 162 square miles, and records since 1904.

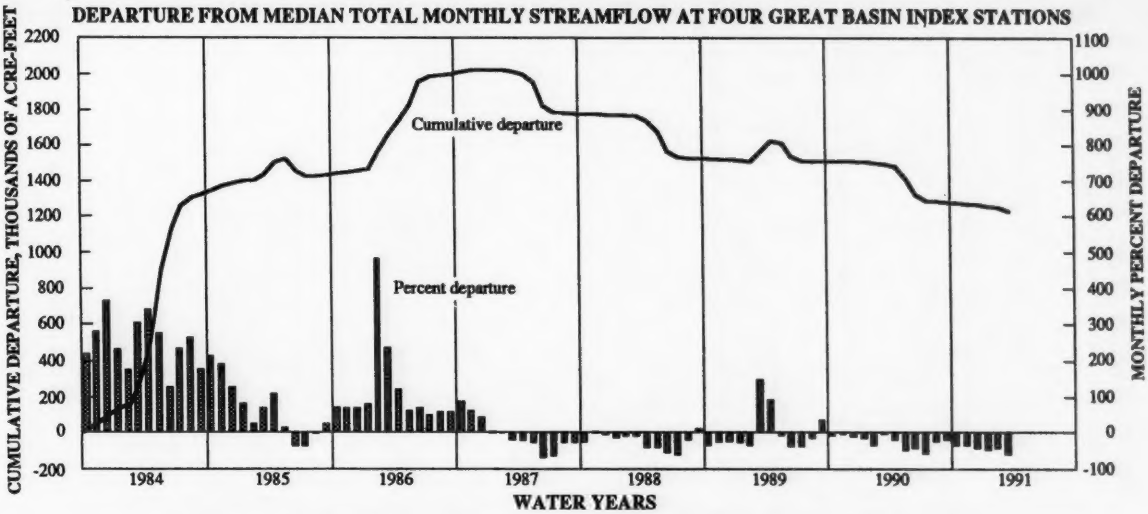
Beaver River near Beaver, Utah—In the southeastern part of the Great Basin, 180 miles southwest of Salt Lake City, draining to the west from the Tushar Mountains into the Rockyford Reservoir, with a drainage area of 91 square miles, and records since 1914.

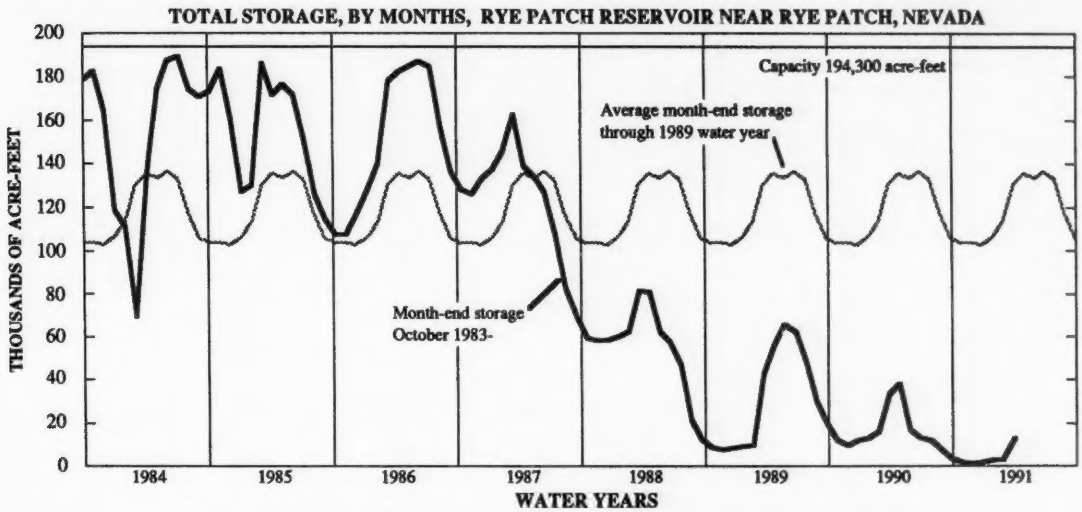
Humboldt River at Palisade, Nevada—In the north-central part of the Great Basin, about 30 miles southwest of Elko, draining to Rye Patch Reservoir, with a drainage area of 5,010 square miles, and records since 1911.

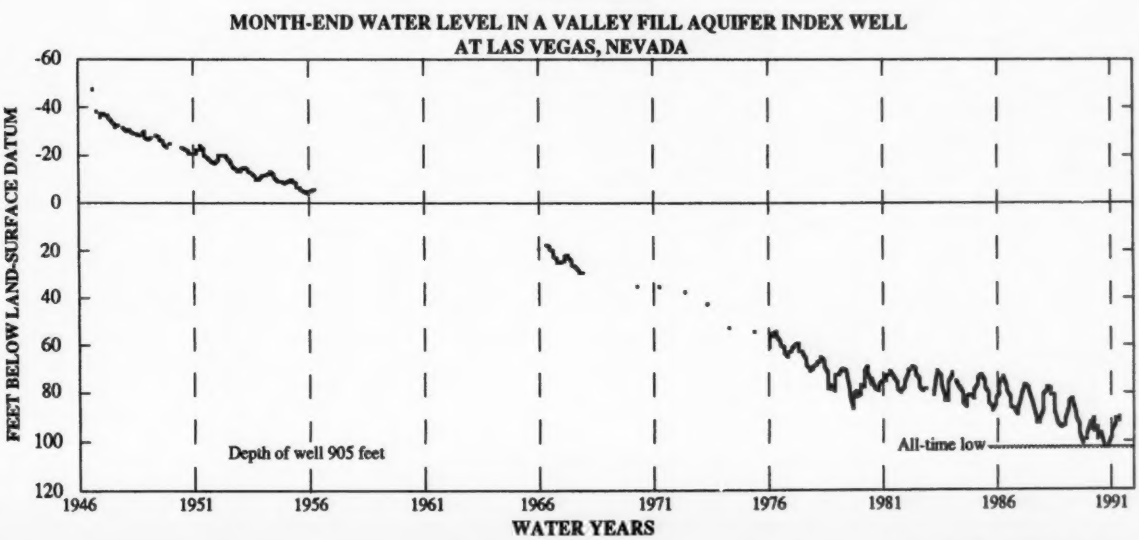
West Walker River below Little Walker River, near Coleville, California—On the eastern side of the Sierra Nevada in north-central California, draining to Walker Lake in Nevada, with a drainage area of 180 square miles, and records since 1939.

There are three index reservoirs in the Great Basin. End-of-month contents for Rye Patch Reservoir (see table on page 13) were chosen to show the progression from wet to dry years. The other two reservoirs in the Great Basin, Bear Lake and Lake Tahoe, have been similarly affected by a series of dry years. Lake Tahoe has had no usable contents for six consecutive months, while Bear Lake has been below month-end averages for several months. [Rye Patch was chosen to represent reservoir contents since: (1) Lake Tahoe has been dry for many months during the past two years; (2) the capacity of Bear Lake is about twice that of Lake Tahoe and about seven times that of Rye Patch; (3) Bear Lake is near the Great Salt Lake; and (4) a graph of the combined contents of the three reservoirs would be biased because of large differences in capacity.] The largest "reservoir" in the basin, Great Salt Lake, is not man-made. The lake's level (see graph on page 14) is now 9.15 feet below the recorded high of 4,211.85 feet above National Geodetic Vertical Datum of 1929, which occurred in two consecutive years: June 1986 and March-April 1987. The downward trend of the Great Salt Lake for the past four years is ample evidence of the dryness of those years in comparison to several very wet years prior to 1987.

Month-end water levels in the valley fill aquifer index well at Las Vegas show a long-term decline, from flowing conditions at the time record began to about 100 feet below land-surface datum at the present time. Water levels during the two most recent years appear to have less range between seasonal lows and highs than past years, but it is difficult to ascribe that condition to drought.

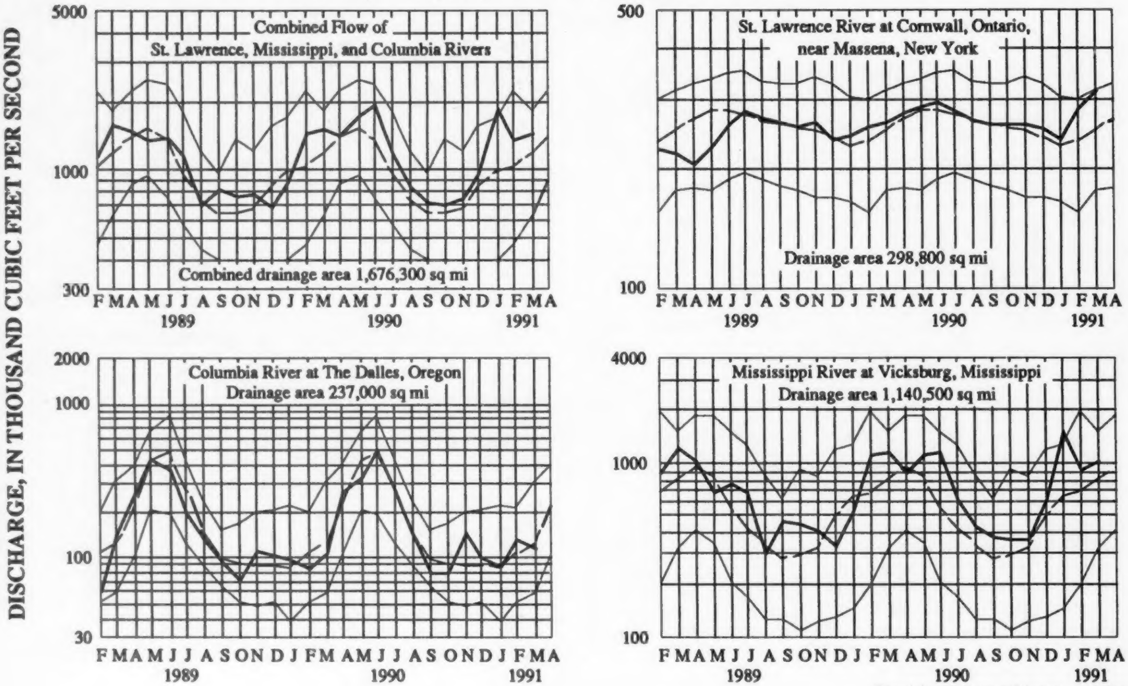

DEPARTURE FROM MEDIAN TOTAL MONTHLY STREAMFLOW AT FOUR GREAT BASIN INDEX STATIONS
CUMULATIVE DEPARTURE, THOUSANDS OF ACRE-FEET
MONTHLY PERCENT DEPARTURE
Cumulative departure
Percent departure
WATER YEARS


TOTAL STORAGE, BY MONTHS, RYE PATCH RESERVOIR NEAR RYE PATCH, NEVADA
THOUSANDS OF ACRE-FEET
Capacity 194,300 acre-feet
Average month-end storage through 1989 water year
Month-end storage October 1983-
WATER YEARS


MONTH-END WATER LEVEL IN A VALLEY FILL AQUIFER INDEX WELL AT LAS VEGAS, NEVADA
FEET BELOW LAND-SURFACE DATUM
Depth of well 905 feet
All-time low
WATER YEARS

HYDROGRAPHS FOR THE "BIG THREE" RIVERS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR MARCH 1991, AT DOWNSTREAM SITES ON FIVE LARGE RIVERS

Station number	Station name	March data of following calendar years	Stream discharge during month	Dissolved-solids concentration[1]		Dissolved-solids discharge[1]			Water temperature[2]		
			Mean (cfs)	Minimum (mg/L)	Maximum (mg/L)	Mean (tons per day)	Minimum (tons per day)	Maximum (tons per day)	Mean in °C	Minimum in °C	Maximum in °C
01463500	Delaware River at Trenton,	1991	18,110	75	98	4,263	2,673	8,419	6.5	4.0	9.5
	New Jersey, (Morrisville,	1945-90	19,750	44	145	[3]3,654	1,100	98,100	[3]5.5	0	8.5
	Pennsylvania)	(Extreme yr)		(1945)	(1990)		(1980)	(1978)			
			[4]20,040								
07289000	Mississippi River at	1991	1,025,000	162	201	498,700	455,600	545,200	10.0	7.0	12.5
	Vicksburg, Mississippi	1976-90	930,900	143	320	992,000	108,000	803,000	10.0	5.0	14.5
		(Extreme yr)		(1989)	(1988)		(1981)	(1979)			
			[4]814,500								
03612500	Ohio River at lock and dam 53,	1991	675,000	158	220	......	261,000	485,000	...	7.0	13.0
	near Grand Chain, Illinois,	1955-90	524,200	128	312	......	50,000	776,000	...	0.5	14.5
	(streamflow station at Metropolis,	(Extreme yr)		(1955,	(1968)		(1986)	(1979)			
	Illinois)		[4]578,300	1964)							
06934500	Missouri River at Hermann,	1991	42,800	361	399	42,900	32,600	62,000	11.0	5.0	17.5
	Missouri. (60 miles west of	1976-90	108,100	186	530	91,190	29,300	199,000	8.0	0	15.0
	St. Louis, Missouri)	(Extreme yr)		(1978)	(1981)		(1977)	(1979,			
			[4]74,200					1984)			
14128910	Columbia River at Warrendale,	1991	214,000	95	101	56,900	47,200	65,700	5.5	5.0	7.0
	Oregon (streamflow station at	1976-90	194,100	87	136	55,900	25,600	114,300	6.0	3.0	8.0
	The Dalles, Oregon)	(Extreme yr)		(1980,	(1986)		(1980)	(1983)			
			[4]123,000	1986)							

[1]Dissolved-solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.

[2]To convert °C to °F: [(1.8 x °C) + 32] = °F.

[3]Mean for 7-year period (1983-90).

[4]Median of monthly values for 30-year reference period, water years 1951-80, for comparison with data for current month.

Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING MARCH 1991

Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1985 (cubic feet per second)	March 1991: Monthly mean discharge (cubic feet per second)	March 1991: Percent of median monthly discharge 1951–80	March 1991: Change in discharge from previous month (percent)	Discharge near end of month: Cubic feet per second	Discharge near end of month: Million gallons per day	Discharge near end of month: Date
01014000	St. John River below Fish River at Fort Kent, Maine	5,665	9,758	3,750	155	23	6,700	4,330	31
01318500	Hudson River at Hadley, New York	1,664	2,908	4,990	166	97	5,730	3,700	31
01357500	Mohawk River at Cohoes, New York	3,456	5,683	10,700	102	52	9,000	5,800	31
01463500	Delaware River at Trenton, New Jersey	6,780	11,670	18,110	90	30	16,000	10,300	31
01570500	Susquehanna River at Harrisburg, Pennsylvania	24,100	34,340	64,400	89	43	59,100	38,200	27
01646500	Potomac River near Washington, District of Columbia	11,560	[1]11,500	[1]26,400	108	105	......	......	...
02105500	Cape Fear River at William O. Huske Lock, near Tarheel, North Carolina	4,852	5,002	7,830	78	121	......	......	...
02131000	Pee Dee River at Peedee, South Carolina	8,830	9,871	21,800	121	63	19,500	12,600	31
02226000	Altamaha River at Doctortown, Georgia	13,600	13,730	41,510	132	3	15,100	9,760	31
02320500	Suwannee River at Branford, Florida	7,880	6,986	* 30,900	275	9	29,700	19,200	31
02358000	Apalachicola River at Chattahoochee, Florida	17,200	22,420	43,200	105	37	37,500	24,200	31
02467000	Tombigbee River at Demopolis lock and dam, near Coatopa, Alabama	15,385	23,520	65,340	137	–7	113,000	73,000	31
02489500	Pearl River near Bogalusa, Louisiana	6,573	9,880	24,620	141	11	9,550	6,170	31
03049500	Allegheny River at Natrona, Pennsylvania	11,410	[1]19,580	[1]37,660	93	12	30,100	19,400	26
03085000	Monongahela River at Braddock, Pennsylvania	7,337	[1]12,480	[1]25,760	121	5	26,700	17,300	26
03193000	Kanawha River at Kanawha Falls, West Virginia	8,367	12,550	* 34,600	145	73	37,900	24,500	28
03234500	Scioto River at Higby, Ohio	5,131	4,583	10,860	112	–5	8,220	5,310	31
03294500	Ohio River at Louisville, Kentucky[2]#	91,170	115,800	305,600	123	9	309,000	200,000	31
03377500	Wabash River at Mount Carmel, Illinois	28,635	27,660	61,250	106	4	104,000	67,200	31
03469000	French Broad River below Douglas Dam, Tennessee[3]#	4,543	[1]6,739	12,720	108	18	......	......	...
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wisconsin.[2]	6,010	4,238	4,941	117	66	7,810	5,050	31
04264331	St. Lawrence River at Cornwall, Ontario, near Massena, New York.[4]#	298,800	243,900	* 316,000	126	12	325,000	210,000	31
02NG001	St. Maurice River at Grand Mere, Quebec	16,300	24,910	7,030	84	123	19,700	12,700	27
05082500	Red River of the North at Grand Forks, North Dakota	30,100	2,593	† 764	41	151	1,920	1,240	31
05133500	Rainy River at Manitou Rapids, Minnesota	19,400	12,920	† 5,000	52	–7	7,000	4,500	27
05330000	Minnesota River near Jordan, Minnesota	16,200	3,680	3,007	95	583	8,600	5,560	31
05331000	Mississippi River at St. Paul, Minnesota#	36,800	[1]11,020	8,547	111	160	25,200	16,300	31
05365500	Chippewa River at Chippewa Falls, Wisconsin	5,650	5,149	* 9,647	206	429	20,500	13,200	31
05407000	Wisconsin River at Muscoda, Wisconsin	10,400	8,710	11,150	116	47	33,100	21,400	31
05446500	Rock River near Joslin, Illinois	9,549	6,080	13,140	142	70	19,600	12,700	31
05474500	Mississippi River at Keokuk, Iowa#	119,000	63,790	100,000	119	117	169,000	109,000	31
06214500	Yellowstone River at Billings, Montana	11,795	7,056	† 2,170	70	–15	2,230	1,440	31
06934500	Missouri River at Hermann, Missouri#	524,200	80,880	† 42,810	58	–12	58,300	37,700	31
07289000	Mississippi River at Vicksburg, Mississippi[5]#	1,140,500	584,000	1,025,000	126	11	925,000	598,000	29
07331000	Washita River near Dickson, Oklahoma	7,202	1,402	940	159	26	1,050	678	29
08276500	Rio Grande below Taos Junction Bridge, near Taos, New Mexico.	9,730	742	723	127	22	790	510	31
09315000	Green River at Green River, Utah	44,850	6,391	† 2,825	70	28	......	......	...
11425500	Sacramento River at Verona, California	21,251	19,430	25,340	81	216	......	......	...
13269000	Snake River at Weiser, Idaho	69,200	18,520	† 10,100	51	–6	8,860	5,730	31
13317000	Salmon River at White Bird, Idaho	13,550	11,390	† 4,190	83	7	3,730	2,410	31
13342500	Clearwater River at Spalding, Idaho	9,570	15,510	13,200	103	–15	9,040	5,840	29
14105700	Columbia River at The Dalles, Oregon[6]#	237,000	[1]193,500	[1]116,000	94	–13	187,000	121,000	31
14191000	Willamette River at Salem, Oregon	7,280	[1]23,690	34,850	105	14	14,000	9,000	31
15515500	Tanana River at Nenana, Alaska	25,600	23,810	* 7,548	123	1	7,600	4,910	31
08MF005	Fraser River at Hope, British Columbia	83,800	96,250	* 37,080	115	–31	34,900	22,500	31

#Indicates stations excluded from the combination bar/line graph. See Explanation of Data.

[1]Adjusted.

[2]Records furnished by Corps of Engineers.

[3]Records furnished by Tennessee Valley Authority.

[4]Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y., when adjusted for storage in Lake St. Lawrence.

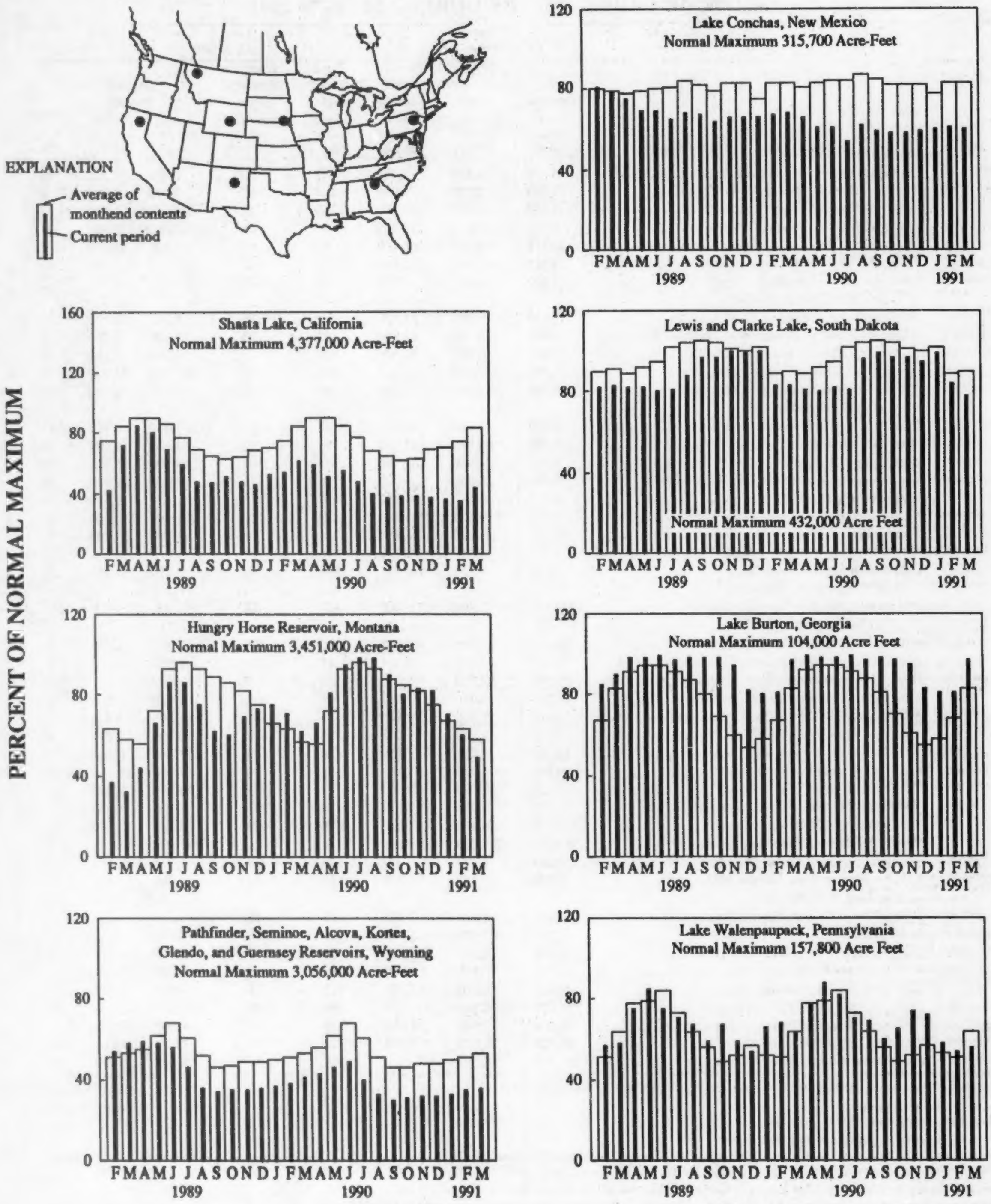
[5]Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[6]Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

* Above-normal range

† Below-normal range

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS



Provisional data; subject to revision

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF MARCH 1991

[Contents are expressed in percent of reservoir (system) capacity. The usable storage capacity of each reservoir (system) is shown in the column headed "Normal maximum"]

Reservoir Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Percent of normal maximum				
	End of March 1991	End of March 1990	Average for end of March	End of February 1991	Normal maximum (acre-feet)[1]
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	† 21	58	64	49	[2]226,300
QUEBEC					
Allard (P)	28	62	32	40	280,600
Gouin (P)	* 59	43	48	65	6,954,000
MAINE					
Seven Reservoir Systems (MP)	* 49	53	36	54	4,107,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	* 26	38	18	26	76,450
Lake Francis (FPR)	* 49	64	23	52	99,310
Lake Winnipesaukee (PR)	68	81	65	54	165,700
VERMONT					
Harriman (P)	* 49	73	35	42	116,200
Somerset (P)	* 65	77	52	63	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	* 89	92	78	86	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	* 64	81	48	54	786,700
Indian Lake (FMP)	* 63	90	49	56	103,300
New York City Reservoir System (MW)	98	99	94	95	1,680,000
NEW JERSEY					
Wanaque (M)	* 100	110	89	93	85,100
PENNSYLVANIA					
Allegheny (FPR)	36	37	35	31	1,180,000
Pymatuning (FMR)	88	89	93	88	188,000
Raystown Lake (FR)	* 67	67	60	67	761,900
Lake Wallenpaupack (PR)	† 56	64	64	54	157,800
MARYLAND					
Baltimore Municipal System (M)	* 99	91	91	98	261,900
NORTH CAROLINA					
Bridgewater (Lake James) (P)	* 98	97	89	86	288,800
Narrows (Badin Lake) (P)	100	98	99	94	128,900
High Rock Lake (P)	* 100	89	81	63	234,800
SOUTH CAROLINA					
Lake Murray (P)	* 92	89	79	85	1,614,000
Lakes Marion and Moultrie (P)	* 88	94	81	80	1,777,000
SOUTH CAROLINA-GEORGIA					
Strom Thurmond Lake (FP)	* 86	79	71	75	1,730,000
GEORGIA					
Burton (PR)	* 97	97	83	81	104,000
Sinclair (MPR)	92	90	89	94	214,000
Lake Sidney Lanier (FMPR)	60	69	59	51	1,686,000
ALABAMA					
Lake Martin (P)	94	95	89	79	1,375,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	* 64	59	51	59	2,293,000
Douglas Lake (FPR)	* 51	49	41	29	1,395,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	68	77	63	57	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	* 68	69	56	60	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	68	76	62	61	1,478,000
WISCONSIN					
Chippewa and Flambeau (PR)	* 81	84	30	67	365,000
Wisconsin River (21 Reservoirs) (PR)	* 50	58	27	42	399,000
MINNESOTA					
Mississippi River Headwater System (FMR)	* 33	35	19	30	1,640,000
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	† 55	59	79	54	22,700,000
SOUTH DAKOTA					
Angostura (I)	† 47	50	78	45	130,770
Belle Fourche (I)	† 33	44	63	28	185,200
Lake Francis Case (FIP)	† 74	75	84	75	4,589,000
Lake Oahe (FIP)	† 61	64	72	59	22,240,000
Lake Sharpe (FIP)	100	103	101	100	1,697,000
Lewis and Clark Lake (FIP)	† 78	83	90	84	432,000
NEBRASKA					
Lake McConaughy (IP)	† 59	71	77	56	1,948,000
OKLAHOMA					
Eufaula (FPR)	97	144	92	94	2,378,000
Keystone (FPR)	† 82	165	101	82	661,000
Tenkiller Ferry (FPR)	* 104	147	97	102	628,200
Lake Altus (FIMR)	* 69	37	54	67	133,000
Lake O'The Cherokees (FPR)	88	118	89	88	1,492,000
OKLAHOMA-TEXAS					
Lake Texoma (FMPRW)	* 98	119	90	95	2,722,000
TEXAS					
Bridgeport (IMW)	* 87	100	50	87	386,400
Canyon (FMR)	* 93	86	81	97	385,600
International Amistad (FIMPW)	* 94	71	83	95	3,497,000
International Falcon (FIMPW)	† 64	47	72	65	2,668,000
Livingston (IMW)	* 100	106	92	104	1,788,000
Possum Kingdom (IMPRW)	88	94	93	92	570,200
Red Bluff (P)	† 24	30	31	24	307,000
Toledo Bend (P)	93	91	88	103	4,472,000
Twin Buttes (FIM)	* 54	48	35	54	177,800
Lake Kemp (IMW)	* 92	100	85	94	268,000
Lake Meredith (FMW)	31	39	36	31	796,900
Lake Travis (FIMPRW)	* 97	68	82	100	1,144,000
MONTANA					
Canyon Ferry (FIMPR)	69	66	74	70	2,043,000
Fort Peck (FPR)	† 55	59	81	55	18,910,000
Hungry Horse (FIPR)	† 49	62	58	60	3,451,000
WASHINGTON					
Ross (PR)	23	21	28	46	1,052,000
Franklin D. Roosevelt Lake (IP)	50	72	50	89	5,022,000
Lake Chelan (PR)	* 58	35	30	68	676,100
Lake Cushman (PR)	85	23	82	83	359,500
Lake Merwin (P)	97	97	97	99	245,600
IDAHO					
Boise River (4 Reservoirs) (FIP)	† 46	54	64	42	1,235,000
Coeur d'Alene Lake (P)	† 54	67	71	104	238,500
Pend Oreille Lake (FP)	† 37	40	49	43	1,561,000
IDAHO-WYOMING					
Upper Snake River (8 Reservoirs) (MP)	† 66	50	72	57	4,401,000
WYOMING					
Boysen (FIP)	* 74	69	64	73	802,000
Buffalo Bill (IP)	† 44	54	59	42	421,300
Keyhole (F)	† 16	25	44	16	193,800
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	† 36	41	53	35	3,056,000
COLORADO					
John Martin (FIR)	† 19	19	25	16	364,400
Taylor Park (IR)	* 66	62	55	68	106,200
Colorado-Big Thompson Project (I)	† 48	37	57	48	730,300
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	† 64	71	70	64	31,620,000
UTAH-IDAHO					
Bear Lake (IPR)	† 36	52	60	35	1,421,000
CALIFORNIA					
Folsom (FIP)	† 37	48	62	16	1,000,000
Hetch Hetchy (MP)	† 18	25	29	7	360,400
Isabella (FIR)	† 11	13	30	7	568,100
Pine Flat (FI)	† 15	10	55	4	1,001,000
Clair Engle Lake (Lewiston) (P)	† 42	58	81	39	2,438,000
Lake Almanor (P)	* 72	76	57	68	1,036,000
Lake Berryessa (FIMW)	† 44	62	87	36	1,600,000
Millerton Lake (FI)	† 52	48	65	35	503,200
Shasta Lake (FIPR)	† 44	61	83	35	4,377,000
CALIFORNIA-NEVADA					
Lake Tahoe (IPR)	† 0	0	54	0	744,600
NEVADA					
Rye Patch (I)	† 6	17	64	1	194,300
ARIZONA-NEVADA					
Lake Mead and Lake Mohave (FIMP)	* 77	82	69	78	27,970,000
ARIZONA					
San Carlos (IP)	* 45	5	31	21	935,100
Salt and Verde River System (IMPR)	* 83	50	54	49	2,019,100
NEW MEXICO					
Conchas (FIR)	† 60	68	83	61	315,700
Elephant Butte and Caballo (FIPR)	* 65	76	42	67	2,394,000

[1] 1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second per day.

[2] Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

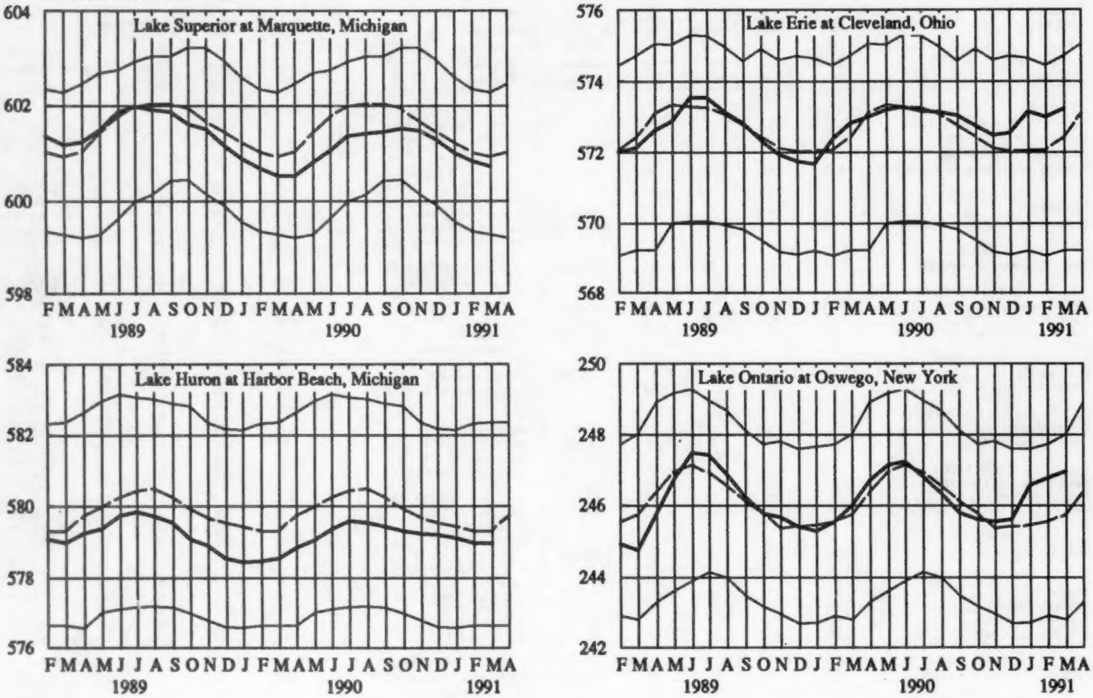
* Above-average range

† Below-average range

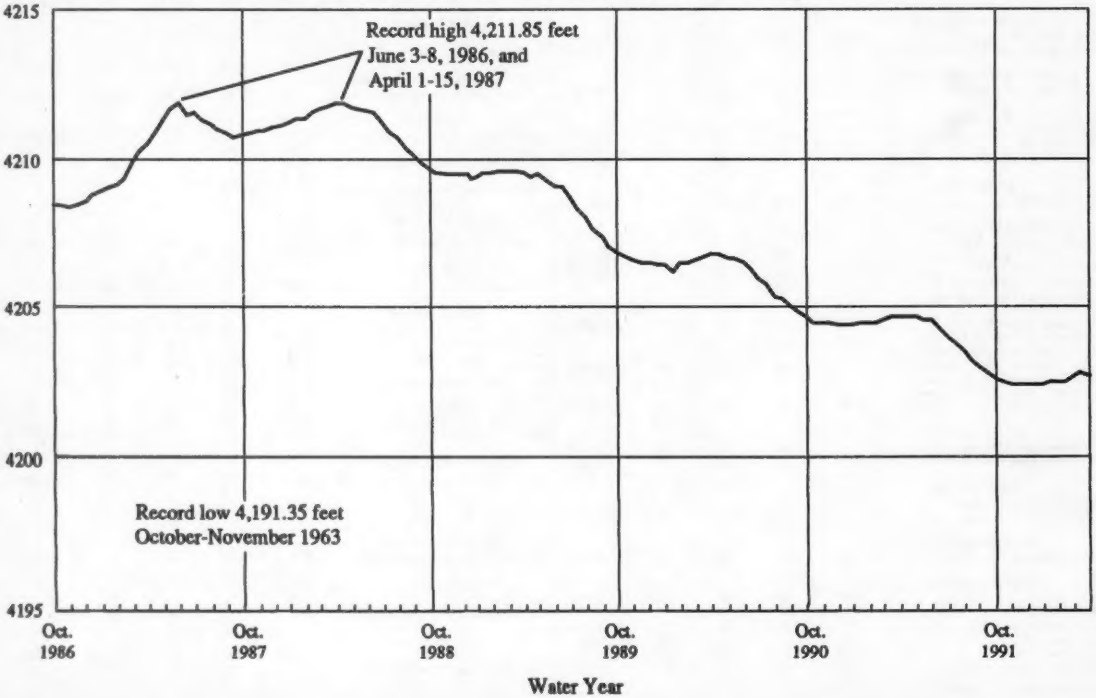
GREAT LAKES ELEVATIONS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Ocean Service.

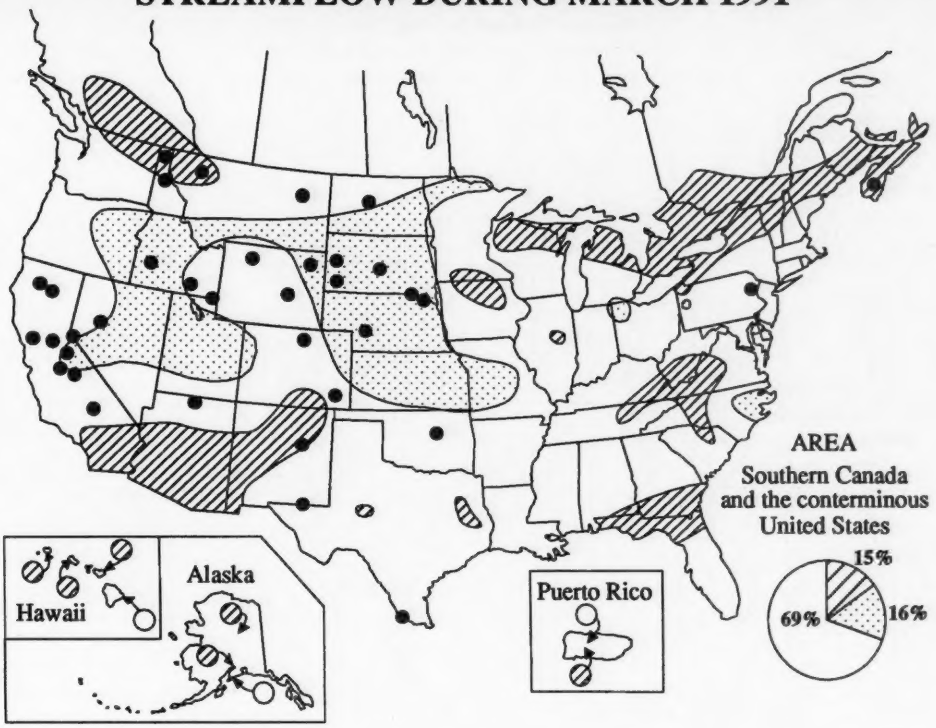
ELEVATION, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929



Fluctuations of the Great Salt Lake, October 1985 through March 1991



STREAMFLOW DURING MARCH 1991

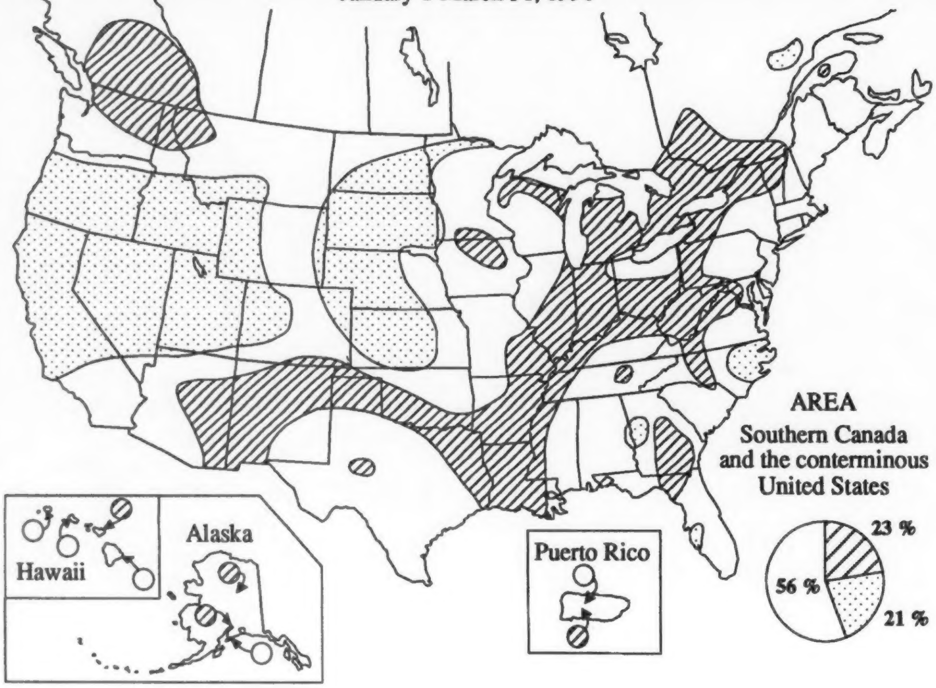


STREAMFLOW DURING MARCH 1990

Above-normal range   Below-normal range   • Below-average reservoir storage

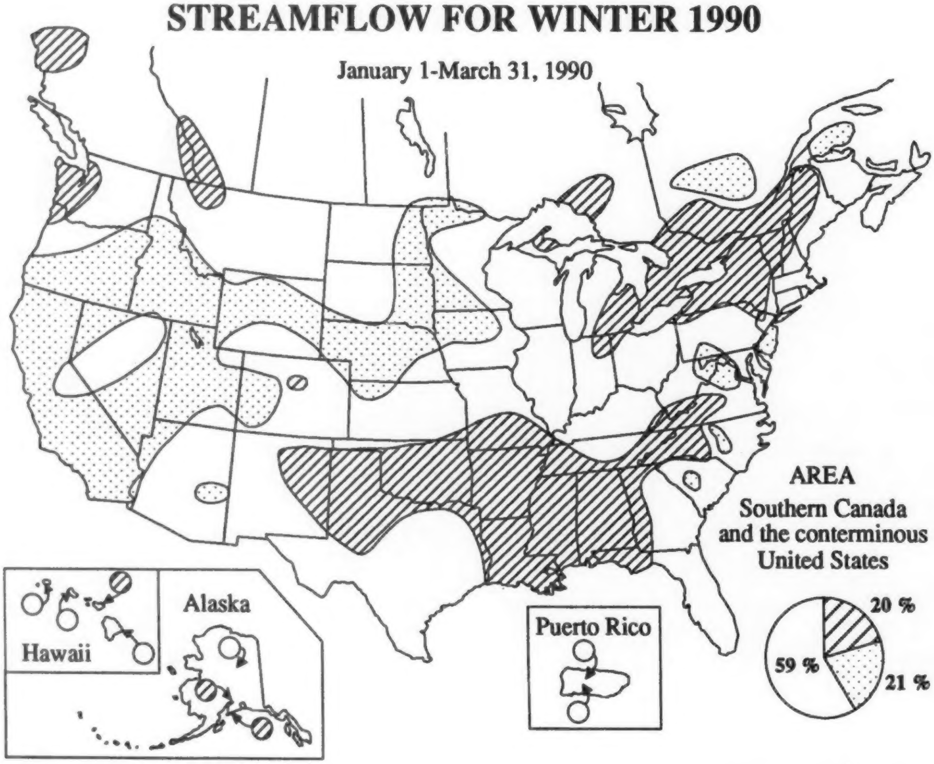
STREAMFLOW FOR WINTER 1991

January 1-March 31, 1991



STREAMFLOW FOR WINTER 1990

January 1-March 31, 1990



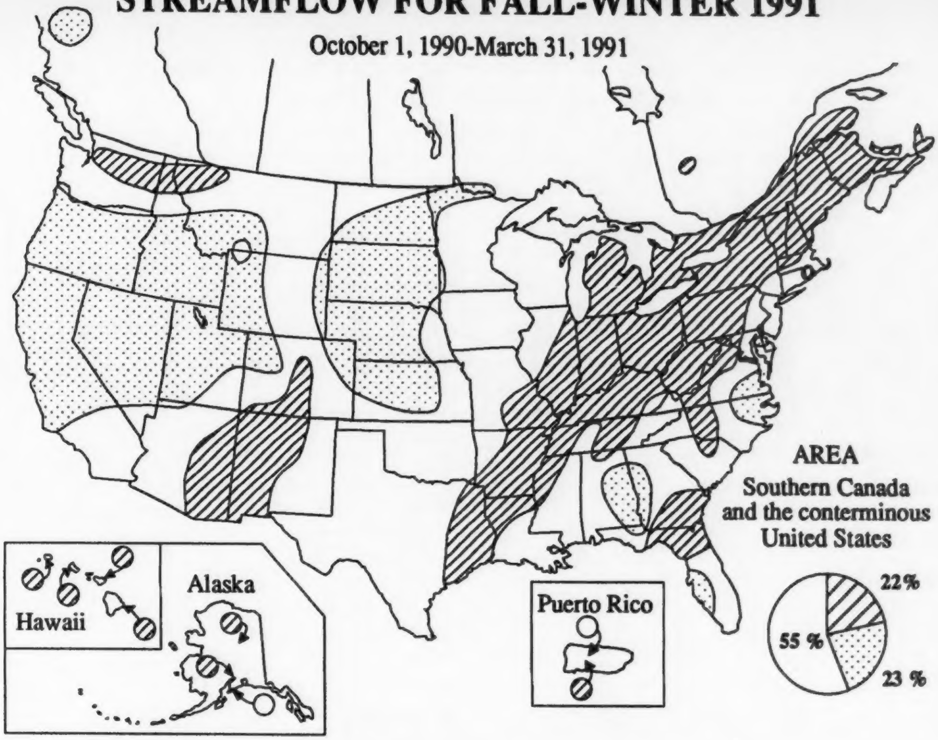
Above-normal range

Normal range

Below-normal range streamflow

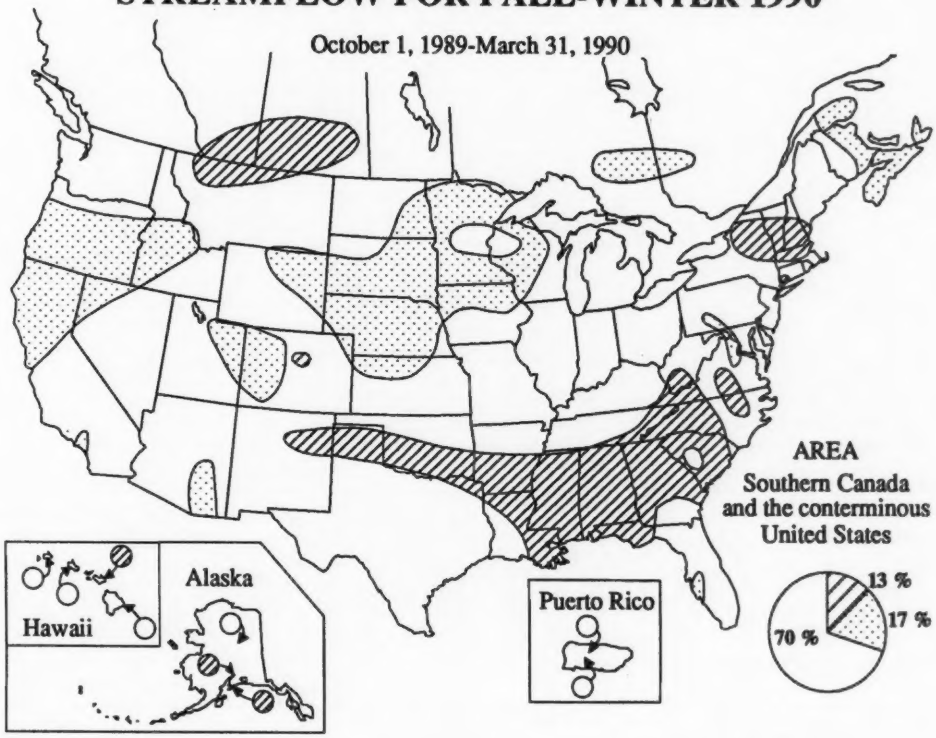
STREAMFLOW FOR FALL-WINTER 1991

October 1, 1990-March 31, 1991



STREAMFLOW FOR FALL-WINTER 1990

October 1, 1989-March 31, 1990

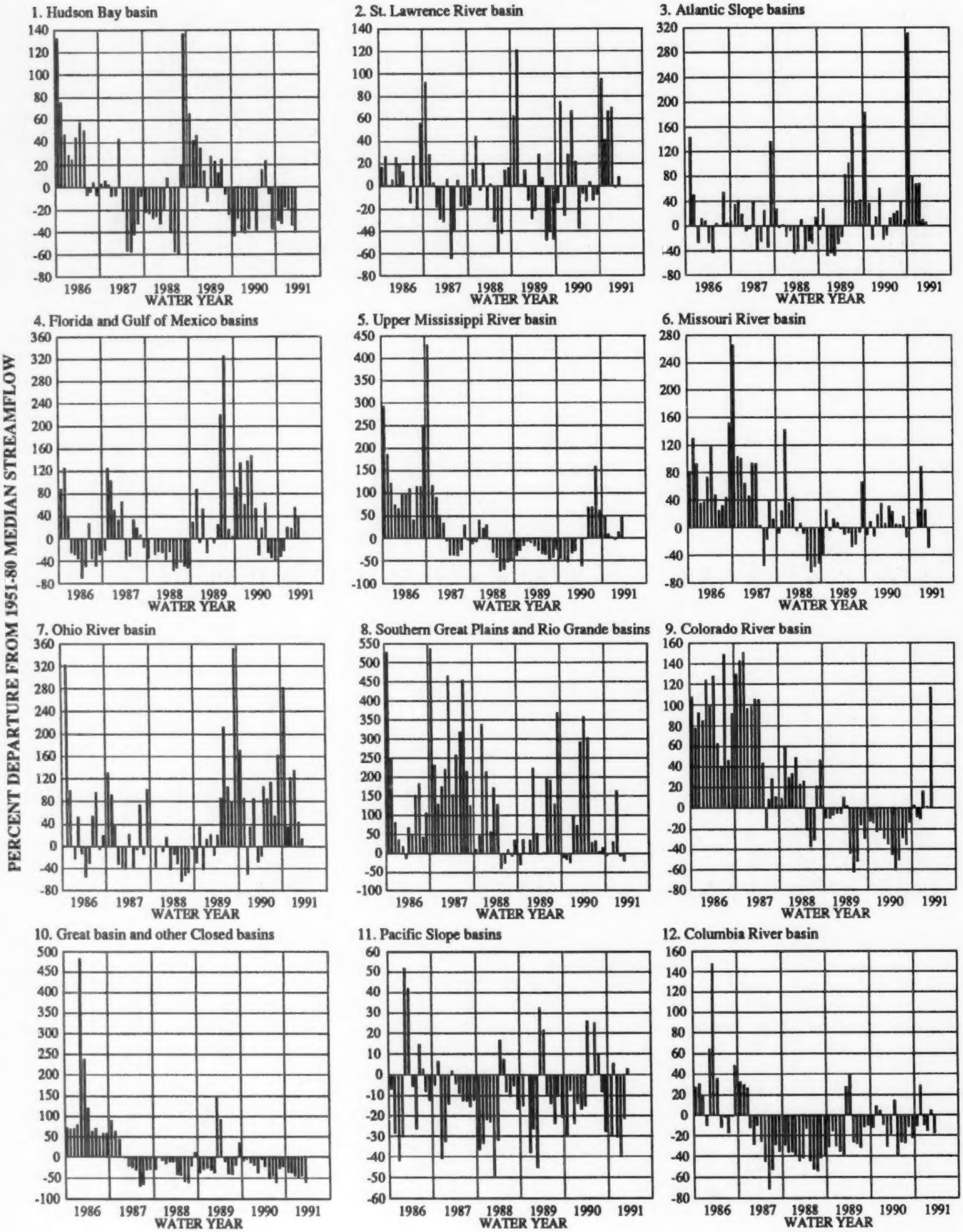


Above-normal range

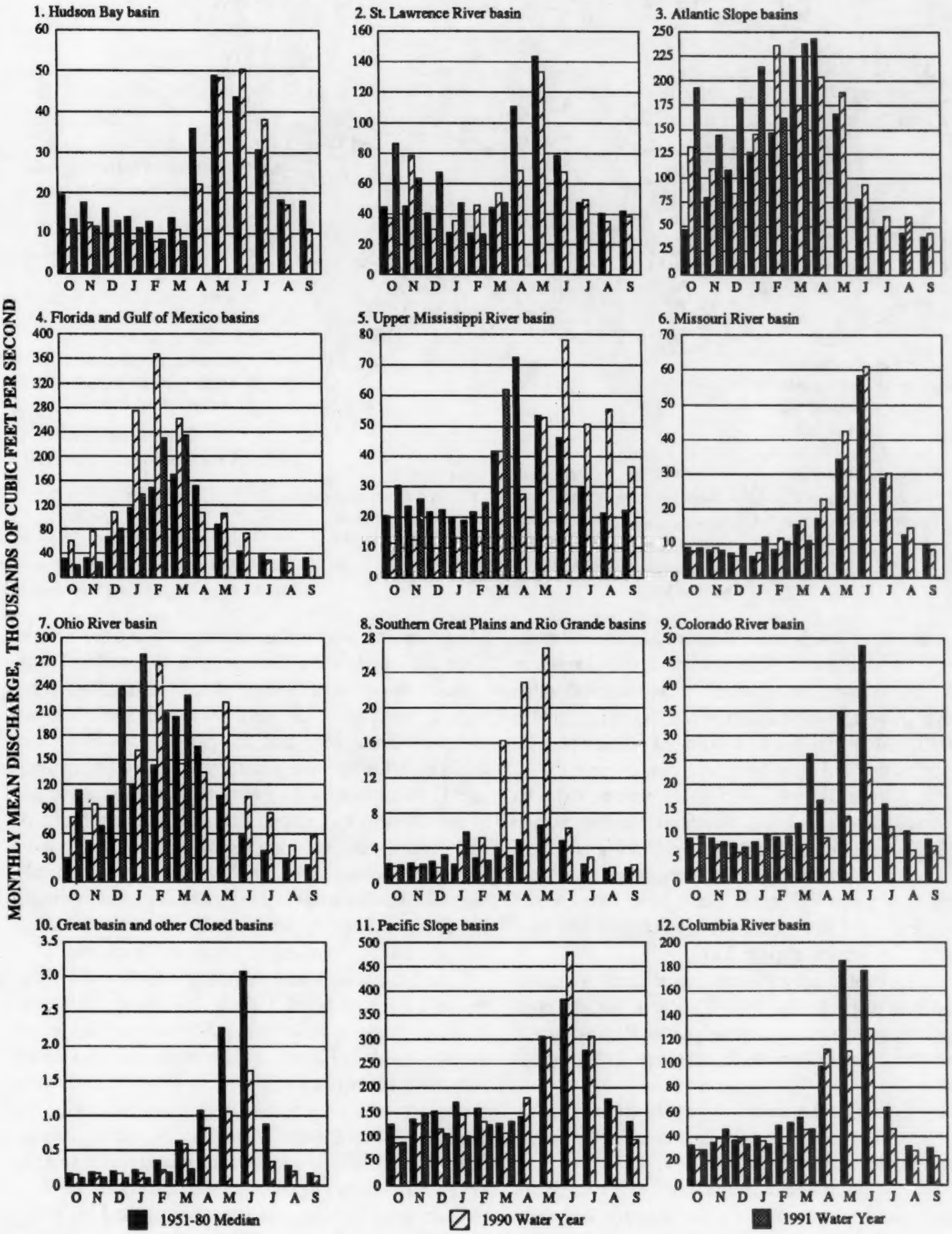
Normal range

Below-normal range streamflow

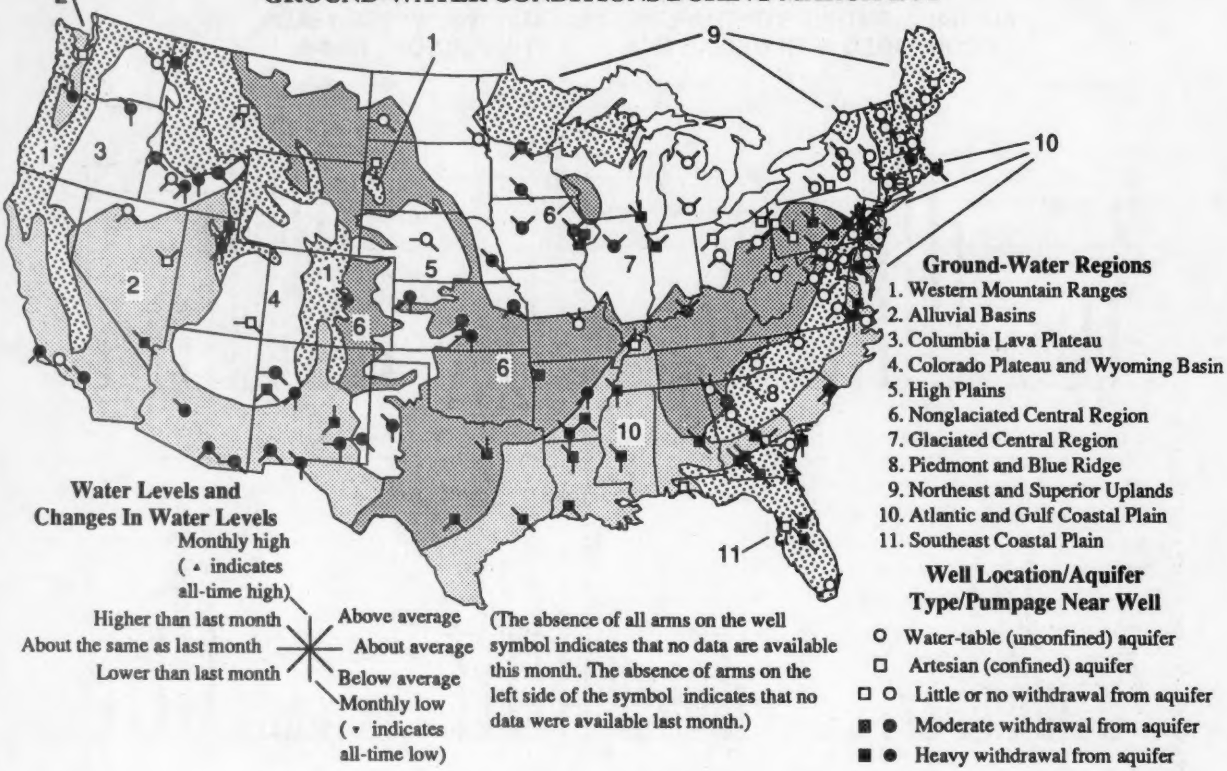
MONTHLY DEPARTURE OF ACTUAL STREAMFLOW (OCTOBER 1985-MARCH 1991) FROM MEDIAN STREAMFLOW (1951-80)



ACTUAL MONTHLY STREAMFLOW, 1990 AND 1991 WATER YEARS, COMPARED WITH MEDIAN MONTHLY STREAMFLOW, 1951-80



GROUND-WATER CONDITIONS DURING MARCH 1991



Ground-water levels in the Western Mountain Ranges were above last month's levels and above long-term averages in Washington and Idaho, but below last month's levels and averages in Montana. A March low occurred in the well in Montana. (See new extremes table on page 22 for data on this and other wells with new extremes.)

In the Alluvial Basins, water levels were mixed with respect to last month's levels. Levels were above average in Washington, Oregon, and parts of Nevada and New Mexico and below average elsewhere. March lows occurred in wells in California, Utah, New Mexico, and Texas, and highs occurred in wells in Oregon and New Mexico. (See graphs on page 23.)

In the Columbia Lava Plateau, water levels were also mixed with respect to last month's levels, but remained below long-term averages throughout the Region. March lows occurred in wells in Idaho and Oregon. (See graphs on page 23.)

In the Colorado Plateau and Wyoming Basin, ground-water levels were at or below last month's levels and below long-term averages.

In the High Plains Region, water levels were mixed with respect to last month's and remained below long-term averages throughout the Region. Water level fell to a March low in a well in Kansas and, despite a rise in level since last month, a low also occurred in a well in Texas.

Water levels in the Non-glaciated Central Region remained the same or fell from last month's levels in the Dakotas, Kansas, Maryland, and part of Texas. Elsewhere levels rose. Levels were generally below long-term averages in the northern and western states, and above average in the southern and eastern states with the exception of Maryland where they were below average. March lows occurred in wells in Kansas and South Dakota, and monthly highs occurred in wells in Texas, Missouri, Pennsylvania and Georgia. (See graphs on page 23.) Water level in a well in North Dakota equalled the previous March low.

In the Glaciated Central Region, levels were above last month's levels in North Dakota, Minnesota, Nebraska, Michigan, Indiana, New York, and New Jersey; below last month's levels in Kansas, and Pennsylvania; and mixed with respect to last month's levels elsewhere. Levels were above long-term average in Michigan and Indiana; below average in North Dakota, Minnesota, Nebraska, Kansas, Pennsylvania, and New Jersey; and mixed with respect to long-term averages elsewhere. March lows occurred in wells in Iowa, Illinois, and Pennsylvania and highs occurred in wells in Iowa and Illinois.

Provisional data; subject to revision

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES–MARCH 1991

GROUND–WATER REGION Aquifer and Location	Aquifer type and local aquifer pumpage	Depth of well in feet	Water level in feet below land–surface datum	Departure from average in feet	Net change in water level in feet since: Last month	Last year	Year records began	Remarks
WESTERN MOUNTAIN RANGES (1)								
Rathdrum Prairie aquifer near Athol, northern Idaho	●	485	461.7	0.3	0.7	5.3	1929	
ALLUVIAL BASINS (2)								
Alluvial valley fill aquifer in Steptoe Valley, Nevada	□	122	7.54	4.27	.17	–.76	1949	
Alluvial sand and gravel aquifer, Baldwin Park, California	●	200	188.12	–72.02	.16	–8.73	1932	Mar. low
Valley fill aquifer, Elfrida area near Douglas, Arizona	◍	124	100.42	–18.65	–.01	–1.52	1947	
Hueco bolson aquifer at El Paso, Texas	●	640	270.93	–20.26	.20	–.97	1964	Mar. low
COLUMBIA LAVA PLATEAU (3)								
Snake River Plain aquifer near Eden, Idaho	●	208	130.0	–8.2	–1.5	–1.3	1962	Mar. low
Columbia River basalt aquifer, Pendleton, Oregon	◍	1,501	217.50	–32.27	.57	–3.08	1965	Mar. low
COLORADO PLATEAU AND WYOMING BASIN (4)								
Dakota aquifer near Blanding, Utah	□	140	47.87	–1.04	.07	–5.15	1960	
HIGH PLAINS (5)								
Wind–blown sand deposits of the High Plains aquifer system near Dunning, Nebraska	○	13	3.60	–.50	–.01	–.23	1934	
Southern High Plains aquifer, Lovington, New Mexico	◍	212	59.60	–5.83	0	.06	1971	
NON–GLACIATED CENTRAL REGION (6)								
Sentinel Butte aquifer near Dickinson, North Dakota	○	160	21.14	–2.96	.02	–1.01	1968	
Sand and gravel Pleistocene aquifer near Valley Center, Kansas	●	54	20.40	–2.80	0	–.86	1937	Mar. low
Glacial outwash sand and gravel aquifer near Louisville, Kentucky	●	94	17.02	7.62	.41	1.85	1945	
Upper Pennsylvanian aquifer in the Central Appalachians Plateau near Glenville, West Virginia	○	25	14.68	1.16	.37	–.69	1953	
GLACIATED CENTRAL REGION (7)								
Fluvial sand and gravel aquifer, Platte River Valley, near Ashland, Nebraska	●	12	6.07	–1.50	.58	.03	1933	
Sheyenne Delta aquifer near Wyndmere, North Dakota	○	40	8.32	–1.88	.52	.20	1963	
Pleistocene (glacial drift) aquifer at Princeton in northern Illinois	◍	29	5.50	3.42	.75	–.10	1942	
Shallow drift aquifer near Roscommon in north–central part of Lower Peninsula, Michigan	○	14	3.96	.56	1.03	.45	1934	
Silurian–Devonian carbonate aquifer near Dola, Ohio	□	51	6.56	.50	–.34	–.37	1954	
PIEDMONT AND BLUE RIDGE (8)								
Water–table aquifer in Petersburg Granite, southeastern Piedmont, Colonial Heights, Virginia	○	100	16.62	–2.36	–1.95	–2.33	1939	
Weathered granite aquifer, western Piedmont, Mocksville area, North Carolina	○	31	13.63	5.25	1.33	.87	1981	
Surficial aquifer at Griffin, Georgia	○	30	15.85	–2.81	1.48	–3.89	1943	
NORTHEAST AND SUPERIOR UPLANDS (9)								
Pleistocene glacial outwash aquifer, at Camp Ripley, near Little Falls, Minnesota	◍	59	15.79	–2.2	–.25	–.21	1949	
Glacial till aquifer at Augusta, Maine	○	22	3.55	1.15	2.65	1.14	1960	
Shallow sand aquifer (glacial deposits), Acton, Massachusetts	●	34	17.78	.49	.20	.41	1965	
Pleistocene sand aquifer near Morrisville, Vermont	○	50	18.47	–.12	.14	–.62	1966	
ATLANTIC AND GULF COASTAL PLAIN (10)								
Columbia deposits aquifer near Camden, Delaware	○	11	6.82	–.73	–.02	–.79	1950	
Memphis sand aquifer near Memphis, Tennessee	■	384	106.37	–15.96	.96	.48	1940	Mar.low
Eutaw aquifer in the City of Montgomery, Alabama	■	270	25.4	–6.6	.7	–5.4	1952	
Evangeline aquifer at Houston, Texas	■	1,152	305.24	–8.79	1.17	–3.45	1978	
SOUTHEAST COASTAL PLAIN (11)								
Upper Floridan aquifer on Cockspur Island, Savannah area, Georgia	■	348	36.26	–9.80	.47	–3.16	1956	Mar.low
Upper Floridan aquifer, Jacksonville, Florida	■	905	–21.4	–7.2	.6	0	1930	
Biscayne aquifer near Homestead, Florida	○	20	8.09	.27	.15	-.06	1932	

In the Piedmont and Blue Ridge, water levels were above last month's except in one well in Virginia. Levels were above long-term averages except in part of Virginia and in Georgia. A March high occurred in a well in North Carolina.

In the Northeast and Superior Uplands, levels were at or above last month's except in Minnesota, Michigan, and New Jersey. Levels were at or below long-term averages in Minnesota, Michigan, Vermont, Connecticut, and parts of New Hampshire, and above average elsewhere.

In the Atlantic and Gulf Coastal Plain, levels declined from last month in South Carolina, Florida, and parts of

NEW EXTREMES DURING MARCH 1991 AT GROUND-WATER INDEX STATIONS

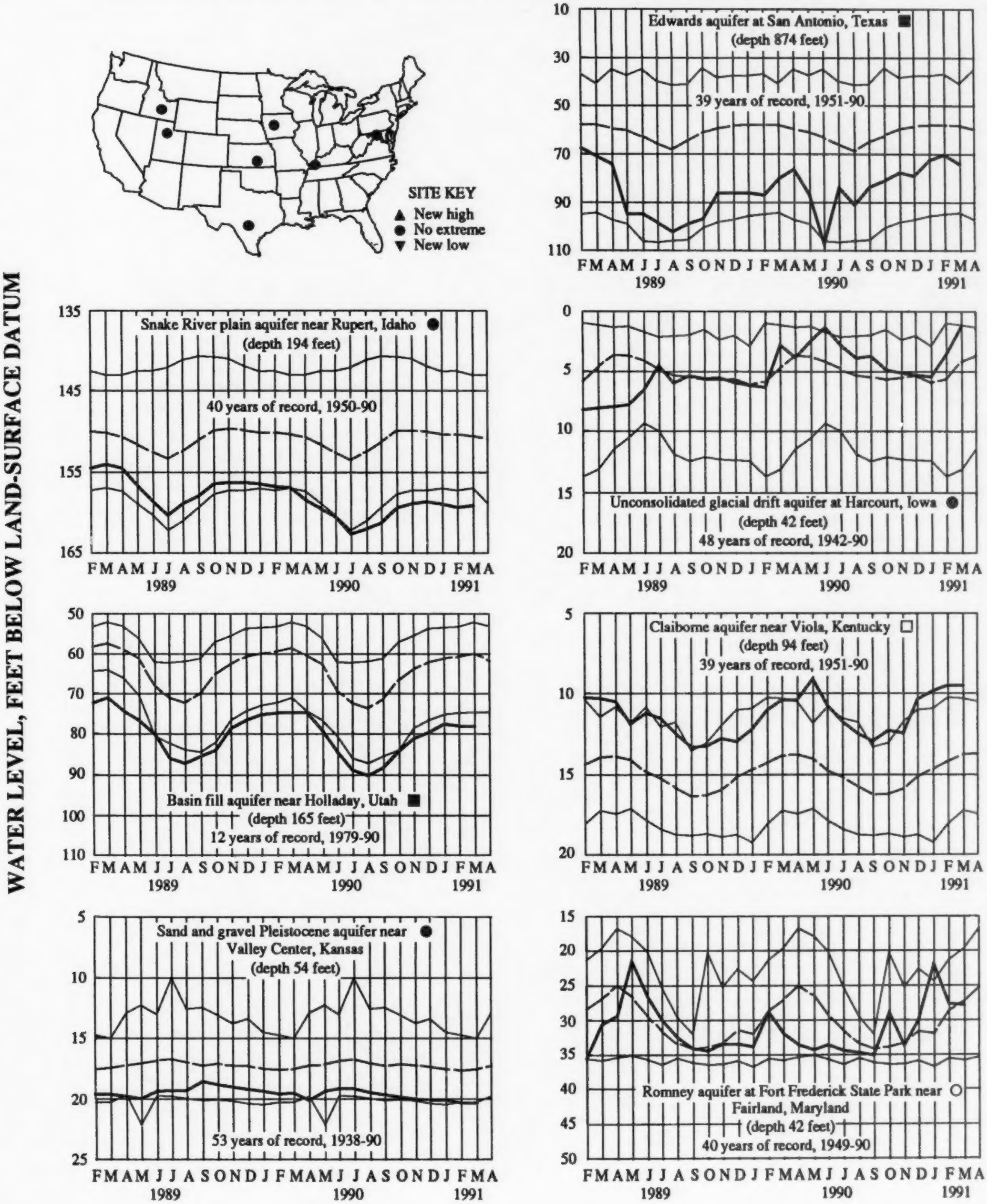
WRD Station Identification Number	Aquifer and Location	Aquifer type and local aquifer pumpage	Depth of well	Years of record	Average (Previous March Record; End-of-month water level in feet below land-surface datum)	Extreme (year) (Previous March Record)	March 1991
	LOW WATER LEVELS						
	WESTERN MOUNTAIN RANGES						
463906112043901	Cretaceous aquifer near Helena, Montana	□	110	14	30.17	35.56 (1989)	35.63
	ALLUVIAL BASINS						
315212106245101	Hueco bolson aquifer at El Paso, Texas	●	640	26	250.67	269.96 (1990)	270.93
324340104231701	Roswell Basin shallow aquifer at Dayton, New Mexico	●	250	39	91.23	122.53 (1987)	122.75
340535117573501	Alluvial sand and gravel aquifer at Baldwin Park, California	●	200	35	116.10	179.39 (1990)	188.12
351051106395301	Basin fill aquifer at Albuquerque, New Mexico	●	980	8	31.25	34.01 (1990)	35.36
403803111505301	Basin fill aquifer near Holladay, Utah	■	165	11	60.00	74.67 (1990)	78.37
414501111520001	Basin fill aquifer near Logan, Utah	■	43	48	-17.4	-12.9 (1989)	-12.3
	COLUMBIA LAVA PLATEAU						
423659114111601	Snake River Plain aquifer near Eden, Idaho	●	208	29	121.18	129.4 (1982)	130.0
424053113412801	Snake River Plain aquifer near Rupert, Idaho	●	194	40	150.6	157.0 (1982)	159.1
453934118491701	Columbia River basalts aquifer at Pendleton, Oregon	●	1,501	24	185.23	214.42 (1990)	217.50
	HIGH PLAINS						
341010102240801	Ogallala aquifer near Lubbock, Texas	●	202	38	56.70	89.30 (1990)	91.45
392329101040201	Ogallala aquifer near Colby, Kansas	●	175	37	118.46	128.25 (1990)	129.54
	NON-GLACIATED CENTRAL REGION						
375039097234201	Sand and gravel Pleistocene aquifer near Valley Center, Kansas	●	54	53	17.60	20.34 (1957)	20.40
375810097324301	Equus aquifer near Halstead, Kansas	●	57	51	22.35	33.48 (1990)	36.55
441759103261201	Minnelusa aquifer near Tilford, South Dakota	□	302	6	24.72	48.01 (1990)	57.51
	GLACIATED CENTRAL REGION						
410940074583401	Sandstone aquifer at Pocono Mountain Lake Estates, Pennsylvania	■	799	9	35.70	48.75 (1989)	59.46
415534091251502	Cambrian-Ordovician aquifer at Mt. Vernon, Iowa	■	1,557	4	335.46	338.26 (1990)	338.48
422803087475302	Lower Mount Simon aquifer at Illinois Beach State Park, Illinios	■	2,264	2	200.42	201.66 (1990)	204.29
	ATLANTIC AND GULF COASTAL PLAIN						
321945090152201	Sparta aquifer system at Jackson, Mississippi	■	852	46	254.26	304.56 (1990)	307.02
322357092341701	Sparta aquifer near Ruston, Louisiana	■	703	16	222.61	235.07 (1990)	236.38
331438092411901	Sparta aquifer near El Dorado, Arkansas	■	540	35	326.41	348.40 (1969)	350.06
335115079033500	Pee Dee aquifer at Collins Park at Conway, South Carolina	■	438	16	33.99	59.88 (1990)	62.32
344607091543401	Mississippi Valley alluvial aquifer near Lonoke, Arkansas	●	135	15	108.25	117.49 (1989)	120.59
350900089482300	Memphis sand aquifer near Memphis, Tennessee	■	384	50	90.41	106.05 (1988)	106.37
364059076544901	Middle Potomac aquifer at Franklin, Virginia	■	305	29	167.86	197.50 (1989)	208.94
372506076511703	Upper Potomac aquifer near Toano, Virginia	●	401	5	158.36	161.26 (1990)	162.05
	SOUTHEAST COASTAL PLAIN						
281715082164401	Upper Floridan aquifer near San Antonio, Florida	□	150	26	38.94	45.40 (1985)	50.28
320202080541201	Upper Floridan aquifer on Cockspur Island near Savannah, Georgia	■	348	35	26.46	34.95 (1989)	36.26
	HIGH WATER LEVELS						
	ALLUVIAL BASINS						
332615104303601	Roswell Basin artesian aquifer at Roswell, New Mexico	■	324	24	55.56	41.82 (1990)	41.80
452938122254801	Troutdale aquifer near Portland, Oregon	●	715	12	100.20	89.04 (1990)	87.44
	NON-GLACIATED CENTRAL REGION						
324842097102901	Twin Mountains (Trinity) aquifer near Hurst/Fort Worth, Texas	■	667	17	458.15	443.59 (1984)	443.30
345403085160001	Paleozoic rock aquifer at Fort Oglethorpe, Georgia	○	72	13	10.59	8.71 (1987)	5.42
375749091475001	Ozark aquifer near Rolla, Missouri	○	450	2	348.26	346.28 (1989)	343.27
402138079031802	Shale aquifer at State Game Land 42, Pennsylvania	□	110	23	16.35	14.70 (1988)	13.91
404140077354801	Carbonate aquifer at Roseann, Pennsylvania	■	200	7	51.16	45.07 (1986)	43.23
	GLACIATED CENTRAL REGION						
414315091252002	Devonion aquifer near Morse, Iowa	■	82	49	15.85	13.63 (1960)	12.76
422803087475304	Ironton-Galesville aquifer at Illinois Beach State Park, Illinois	■	1,203	2	233.68	232.73 (1989)	231.37
	PIEDMONT AND BLUE RIDGE						
355359080331701	Weathered granite aquifer near Mocksville, North Carolina	○	31	9	18.88	14.50 (1990)	13.63
	ATLANTIC AND GULF COASTAL PLAIN						
365210088391301	Claiborne aquifer near Viola, Kentucky	□	106	40	13.81	10.35 (1989)	9.53

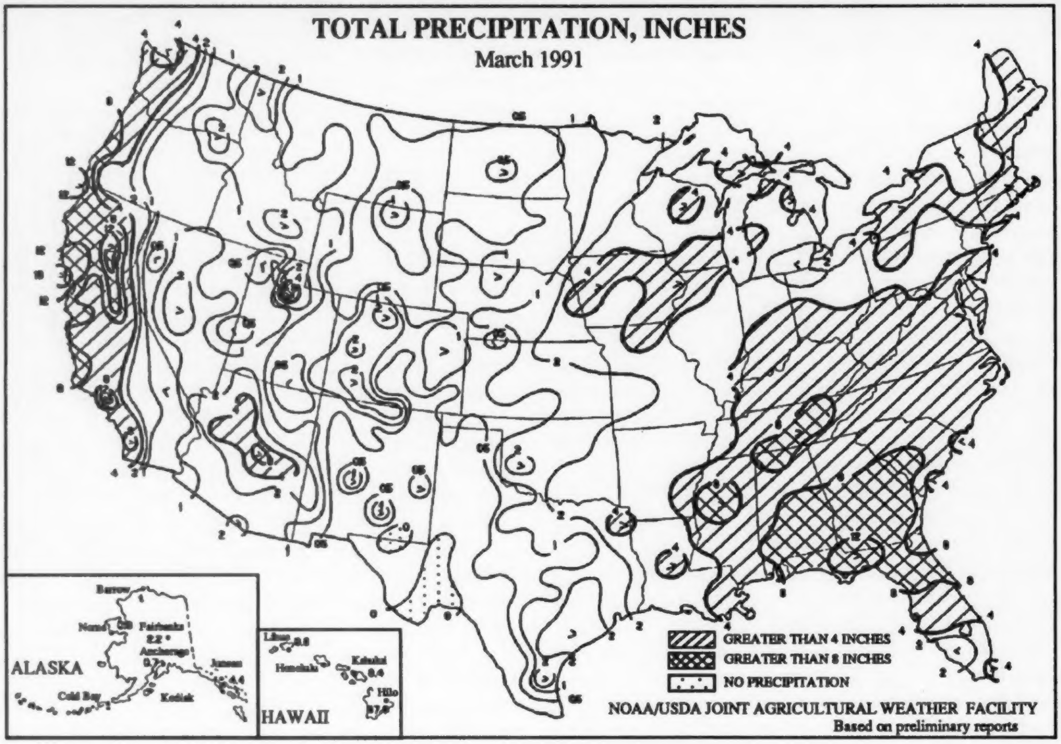
Arkansas and Louisiana, but remained the same or rose elsewhere. Water levels were above long-term averages in North Carolina and Kentucky, mixed in New Jersey and Georgia, and below average elsewhere. March lows occurred in wells in Virginia, South Carolina, Mississippi, Tennessee, Arkansas, and Louisiana. A March high occurred in a well in Kentucky. (See graphs on page 23.)

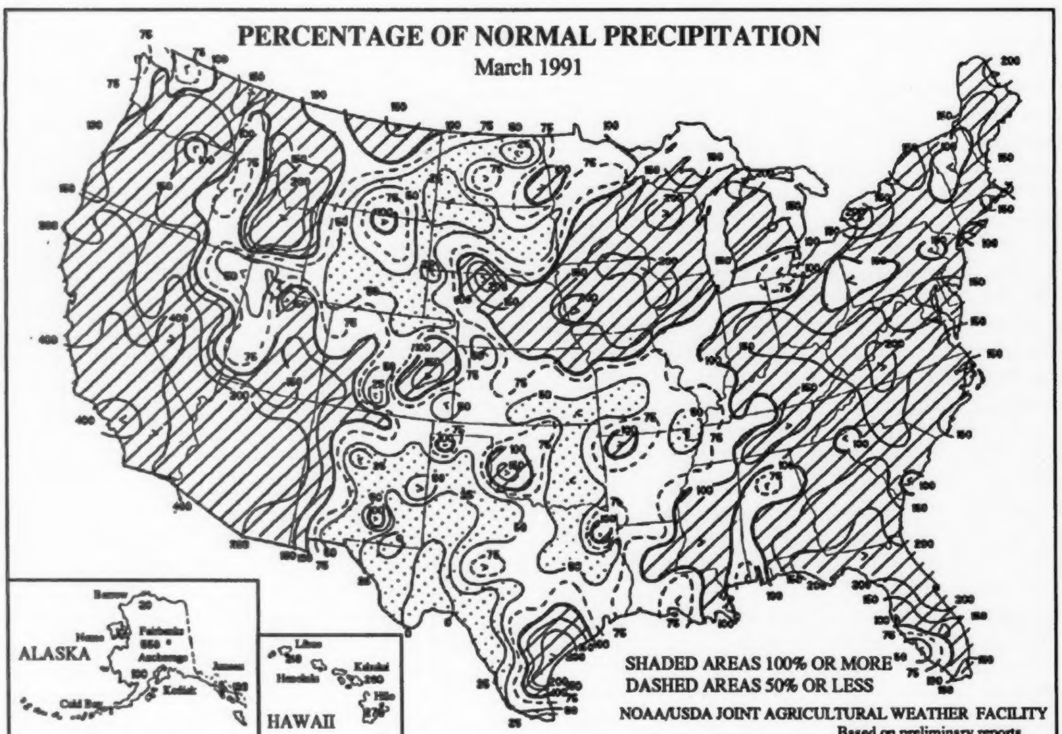
In the Southeastern Coastal Plain, water levels were above last month's levels throughout most of the Region. Levels were mixed with respect to long-term averages. March lows occurred in one well in Georgia and one well in Florida.

MONTHEND GROUND-WATER LEVELS IN SELECTED WELLS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.







(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

MARCH WEATHER AND CROP SUMMARY

A major shift in the North American weather pattern occurred in late February. After a moisture-laden surge of subtropical air brought rain and snow to California, a strong, semi-permanent trough of low pressure took residence off the coast. This provided the impetus for strong storms to form in the west and track across the Nation. The storms dropped abundant moisture on California, added to snowpack in the central and southern Rockies, and delivered sporadic precipitation to the Plains. Precipitation was generally below normal in the Dakotas, southeastern Montana, Kansas, eastern Oklahoma, and northern Texas. Much of the Nation east of the Mississippi River had wetter than normal conditions in March. As the storms churned eastward out of the Rockies, frequent severe thunderstorm outbreaks plagued the Plains, the Midwest, and the Southeast. Tornadoes touched down in most States between the Rockies and the Appalachians.

Polar air repeatedly spilled into the West Coast States and the Southwest behind storm centers, holding temperatures well below normal. But temperatures averaged above normal in all locations east of the Rocky Divide. Frequent southerly winds ahead of storm systems and a lack of polar air intrusion allowed for prolonged warm spells. The warmth was especially notable in the northern and central Plains, where temperatures averaged 4 to 7° F above normal.

In late February and early March, a strong high pressure ridge off the west coast began to drift northwestward. In the void it left behind, a series of storms formed in the Gulf of Alaska and plunged southeastward into California. The seemingly endless supply of cold Pacific energy fueled the Nation's active weather pattern.

California welcomed heavy precipitation during the first 5 days of March. The early-month storms raced eastward, touching off tornadoes along the Gulf coast. A major ice storm damaged orchard trees and knocked out power in New York. The Nation's first 100° F reading of the spring was reported in Laredo, TX, on the 5th. But chilly air began to filter into the eastern two-thirds of the Nation on the 6th. Tallahassee, FL, cooled to 27° F on the 10th.

Active weather returned nationwide during the middle third of the month. Two consecutive storms hit California with heavy rain and snow, hail, and rare tornadoes. High winds swirling around a low pressure center whipped up a dust storm in the central and southern Plains. The same storm dumped heavy snow from eastern Nebraska to Indiana.

Storms turned increasingly destructive during the final 10 days of March. On the 21st and 22nd, tornadoes struck the western Corn Belt and a corridor from Texas to Tennessee. The same storm center was responsible for up to 17 inches of snow in Minnesota and the spreading of wildfires in Oklahoma and the Carolinas. A final flurry of storminess swept across the Nation during the final days of the month. Up to 4 feet of snow fell in the Sierra Nevada of California, and high winds raked the West. Another dust storm swept across Kansas, and blizzard conditions immobilized portion of Nebraska and Iowa. Tornadoes tore through the upper Midwest on the 27th. Two days later, twisters and widespread flooding made for a rough day in the Southeast. But after the month-long spate of chaotic weather, March ended quietly, with flurries around the upper Great Lakes and showers in Florida.

Fieldwork

Rains in California during March interrupted field activities as one weather system after another brought welcome moisture. The Plains and portions of the Mountain States experienced less-than-normal precipitation. A combination of high winds and dry soil caused blowing dust during the middle of the month from Nebraska to the Texas High Plains. However, Iowa had the wettest week in 2 months during that same period.

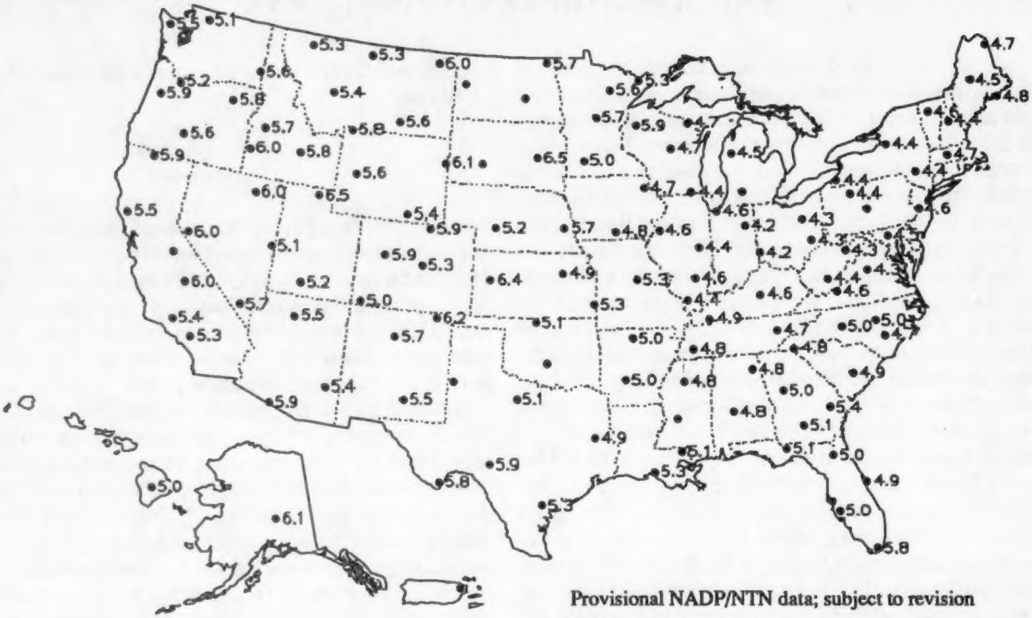
As March began, a few fields of corn were planted in Alabama, Florida, and Georgia. Sorghum and corn planting continued in south Texas, with showers causing a few delays. South Carolina tobacco plants in beds began to grow and were in good condition. Rice planting began in Louisiana. By mid-March, Alabama corn planting was 17 percent complete, 6 percentage points behind normal. Georgia corn was 8 percent planted, compared with 22 percent for the average. Arizona cotton was 2 percent planted. Precipitation and low temperatures slowed planting. Arkansas rice planting began. Louisiana rice was 9 percent planted and 4 percent emerged. Blackbirds continued to be a problem in newly emerged rice fields. The safflower crop began to emerge in California. By the end of the month, corn in Alabama and Georgia was over 40 percent planted. Cotton in Texas was 7 percent planted, 2 points behind normal. Kentucky had considerable soil erosion from heavy winter rains. Tennessee tobacco was 80 percent seeded, 1 point behind normal, with 24 percent of the crop emerged. Colorado and Nebraska sugarbeet planting had begun. Top soil moisture in North Dakota was short to very short.

Winter Wheat

The winter wheat crop was in mostly good condition. Producers topdressed the wheat crop as weather permitted. Early in March, rains benefited the crop on the west coast. Winter wheat was breaking dormancy due to the warm weather in most Southern Plains States. Army cutworms caused moderate damage to wheat in some areas of Kansas. Texas wheat continued to show signs of good progress. However, dry weather, cutworms, and greenbugs concerned producers in the High Plains. By mid-March, the wheat crop was greening in parts of Kansas, Indiana, and eastern Montana. Rains helped revive some drought-stressed wheat in Washington, but the crop was in mostly very poor condition. Army cutworm damage was evident in western Oklahoma. Toward the end of March, rains boosted the wheat condition to mostly good to excellent in Kansas. Army cutworms continued to be a problem, but control measures were reducing the numbers. Irrigated fields in Texas showed good growth, while the dryland fields continued to endure drought-like conditions. Thirty percent of the Oklahoma wheat crop was jointed, 10 points ahead of normal. Montana wheat was green and growing, but eastern counties were critically dry.

(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

pH of Precipitation for February 25-March 24, 1991

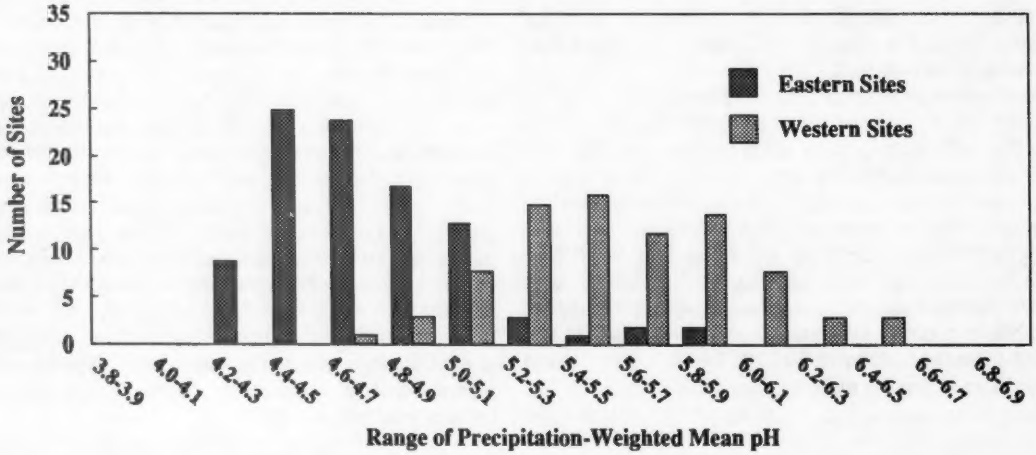


Provisional NADP/NTN data; subject to revision

Current pH data shown on the map (• 4.9) are precipitation-weighted means calculated from preliminary laboratory results provided by the NADP/NTN Central Analytical Laboratory at the Illinois State Water Survey and are subject to change. The 127 points (•) shown on this map represent a subset of all sites chosen to provide relatively even geographic spacing. Absence of a pH value at a site indicates either that there was no precipitation or that data for the site did not meet preliminary screening criteria for this provisional report.

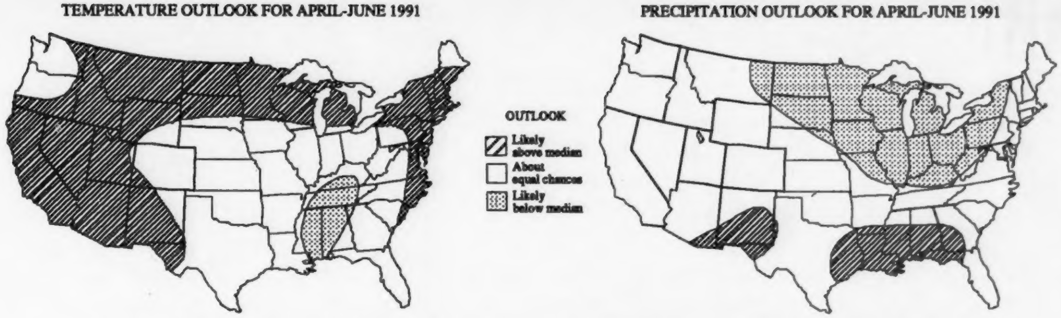
A list of the approximately 200 sites comprising the total Network and additional data for the sites are available from the NADP/NTN Coordination Office, Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523.

Distribution of precipitation-weighted mean pH for all NADP/NTN sites having one or more weekly samples for February 25 to March 24, 1991. The East/West dividing line is at the western borders of Minnesota, Iowa, Missouri, Arkansas, and Louisiana.



TEMPERATURE OUTLOOK FOR APRIL-JUNE 1991

PRECIPITATION OUTLOOK FOR APRIL-JUNE 1991



From *Monthly and Seasonal Weather Outlook* prepared and published by the National Weather Service

NATIONAL WATER CONDITIONS

MARCH 1991

Based on reports from the Canadian and U.S. Field offices; completed April 30, 1991

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EXPLANATION OF DATA (Revised December 1990)

Cover map shows generalized pattern of streamflow for the month based on provisional data from 186 index gaging stations—18 in Canada, 166 in the United States, and 2 in the Commonwealth of Puerto Rico. Alaska, Hawaii, and Puerto Rico inset maps show streamflow only at the index gaging stations that are located near the point shown by the arrows. Classifications on map are based on comparison of streamflow for the current month at each index station with the flow for the same month in the 30-year reference period, 1951-80. Shorter reference periods are used for one Canadian index station, two Kansas index stations, and the Puerto Rico index stations because of the limited records available.

The ***streamflow ranges map*** shows where streamflow has persisted in the above- or below-normal range from last month to this month and also where streamflow is in the above- or below-normal range this month after being in a different range last month. Three ***pie charts*** show: the percent of stations reporting discharges in each flow range for both the conterminous United States and southern Canada, and also the percent of area in each flow range for the conterminous United States and southern Canada. The ***combination bar/line graph*** shows the percent departure of the total mean from the tctal median flow (1951-80) and the cumulative departure from median (in cfs) for all reporting stations (excluding eight large river stations indicated by * in the ***Flow of large rivers*** table) in the conterminous United States and southern Canada.

The comparative data are obtained by ranking the 30 flows for each month of the reference period in order of decreasing magnitude—the highest flow is given a ranking of 1 and the lowest flow is given a ranking of 30. Quartiles (25-percent points) are computed by averaging the 7th and 8th highest flows (upper quartile), 15th and 16th highest flows (middle quartile and median), and the 23rd and 24th highest flows (lower quartile). The upper and lower quartiles set off the highest and lowest 25 percent of flows, respectively, for the reference period. The median (middle quartile) is the middle value by definition. For the reference period, 50 percent of the flows are greater than the median, 50 percent are less than the median, 50 percent are between the upper and lower quartiles (in the normal range), 25 percent are greater than the upper quartile (above normal), and 25 percent are less than the lower quartile (below normal). Flow for the current month is then classified as: in the ***above-normal range*** if it is greater than the upper quartile, in the ***normal range*** if it is between the upper and lower quartiles, and in the ***below-normal range*** if it is less than the lower quartile. Change in flow from the previous month to the current month is classified as ***seasonal*** if the change is in the same direction as the change in the median. If the change is in the opposite direction of the change in the median, the change is classified as ***contraseasonal*** (opposite to the seasonal change). For example: at a particular index station, the January median is greater than the December median; if flow for the current January increased from December (the previous month), the increase is seasonal; if flow for the current January decreased from December, the decrease is contraseasonal.

Flood frequency analyses define the relation of flood peak magnitude to probability of occurrence or recurrence interval. ***Probability of occurrence*** is the chance that a given flood magnitude will be exceeded in any one year. ***Recurrence interval*** is the reciprocal of probability of occurrence and is the average number of years between occurrences. For example, a flood having a probability of occurrence of 0.01 (1 percent) has a recurrence interval of 100 years. ***Recurrence intervals imply no regularity of occurrence***; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Statements about ***ground-water levels*** refer to conditions near the end of the month. The water level in each observation well is compared with average level for the end of the month determined from the entire period of record for that well. ***Changes in ground-water levels***, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data are given for five stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). ***Dissolved solids*** are minerals dissolved in water and usually consist predominately of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. ***Dissolved-solids discharge*** represents the total daily amount of dissolved minerals carried by the stream. ***Dissolved-solids concentrations*** are generally higher during periods of low streamflow, but the highest dissolved-solids discharges occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

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